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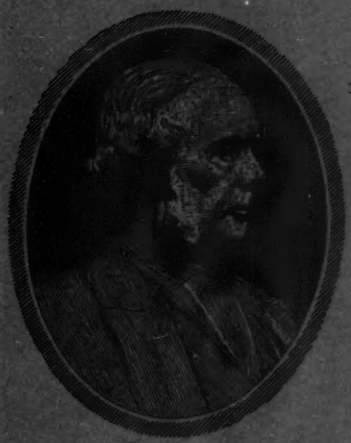

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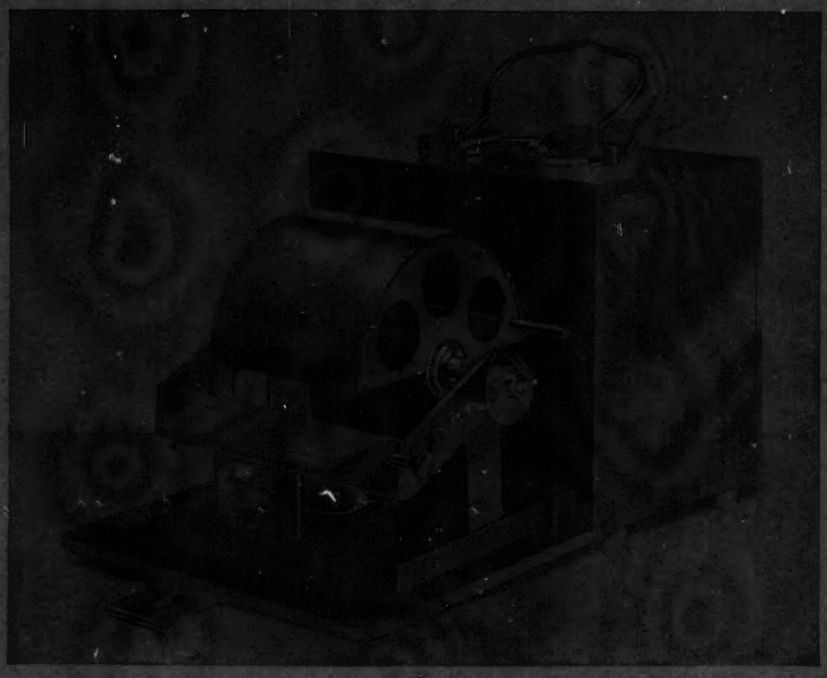

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A STUDY IN INTRAVASCULAR THROMBOSIS WITH SOME NEW CONCEPTIONS OF THE MECHANISM OF COAGULATION

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PART I

(BY HAROLD CUMMINE)

"I shall make every endeavour to present the facts alone and connected by their most striking analogies, and if sometimes I am obliged in this exposition, to have recourse to some theoretical, hypothetical views, I trust that it may be evident that I am not insisting upon them, and that I may never put forward my individual opinion for SCIENCE—*that is to say,* THAT WHICH WE KNOW."—René Laennec.

FOREWORD

THERE is a growing awareness amongst physicians and surgeons that intravascular thrombosis is a more common condition than has previously been thought. With the advent of the antibiotics and bacteriostatics new conceptions have been added to medical thought. The development of an accurate knowledge of inter- and intra-group incompatibilities has made the giving of blood transfusions a safe and simple procedure. The specialized advances in anæsthesia represent an added safeguard to the surgical 'bad risk' patient. These milestones of progress have greatly contributed, with many of lesser importance, to a great reduction in the post-operative mortality and morbidity rates. With the decrease in deaths from sepsis, hæmorrhage, dehydration, and post-anæsthetic pulmonary complications, the true incidence of intravascular thrombosis stands out in sharper relief, and the recognition of this finds illustration in the increased interest in the disease, which has become apparent in the literature.

However, this increased awareness and interest have not resulted in any real advances in the knowledge of the true pathology of the morbid condition giving rise to ante-mortem intravascular clotting. Such prophylactic measures as thyroid administration, early ambulation, and vein interruption have advanced the prevention and, to some extent, the treatment of the condition, but have not served to unmask its pathological identity. The use of the anticoagulant drugs, heparin and dicoumarol, although constituting a major therapeutic advance, have likewise added little true knowledge.

For the past two years work has been carried out in the Department of Surgery at the University of Sydney, and in the wards of the Royal Prince Alfred Hospital, Sydney, with the object of attempting to determine the factors giving rise to intravascular thrombosis and to elaborate a means of detecting the occurrence of these factors prior to the onset of thrombosis. The results of this work provide a basis for what may be suggested as a new conception of the pathology of the disease and will be discussed.

In brief, it appeared from our observations that thrombosis occurred when a variant of fibrinogen (termed by Lyons, Fibrinogen B) was present in the blood in association with venous stasis.

The presence of fibrinogen B is demonstrated by a simple plasma estimation, and it is suggested that by using the routine post-operative coagulation graph, the presence of intravenous thrombin can be detected as it frequently causes a marked decrease in the coagulation time. During the course of this work, the opinion was formed that primary pulmonary thrombosis was much more common than is thought, and that on the other hand, embolism from fragments arising in, and detached from, the veins of the legs was much less common.

RELATIONSHIP OF PULMONARY THROMBOSIS TO PERIPHERAL VENOUS THROMBOSIS

The modern conception that in the main pulmonary embolism, with or without infarction, is but an additional manifestation of intravascular thrombosis in the leg veins and other areas drained by the inferior vena cava, appears on first examination an adequate explanation of the basal pathology of the condition. But a study of the various clinical and autopsy series available in the literature does not

completely support this hypothesis. In attempting to determine the relationship between peripheral vascular thrombosis and pulmonary embolism, it is wise to heed the observation of Belt (1934) that because of the impossibility of examining all veins in routine autopsies " it is impossible to determine the incidence of venous thrombosis accurately ". The majority of authors regard pulmonary thrombosis as invariably due to emboli arising from the thrombus formed in the peripheral venous system, except for those arising from the placental site or from vegetative heart lesions, or possibly from atheromatous patches. On the other hand, some authors, impressed by a failure to detect peripheral venous thrombosis in many instances, are not convinced of such a direct relationship between the two conditions. There is no doubt, however, that both peripheral vascular thrombosis and thrombosis of the pulmonary vessels, either of a spontaneous nature or secondary to an embolic thrombus, are manifestations of a state of primary intravascular thrombosis. The point in doubt is whether pulmonary thrombosis is invariably an embolic phenomenon or a primary disease of local origin. That there is a relationship between the two conditions is apparent from *Table I.*

Table I.

Year	*Author*	*Thrombo-phlebitis*	*Embolism*	*Percentage*	
1913	Schenck	566	—	1·15	
1920	Hampton and Wharton	205	17	8·5	
1929	Miller and Rogers	206	7	3·4	(fatal)
1931	Hosoi	47	8	1·7	
1934	Belt	36	25	69·0	
1941	Faxon and Welch	119	35	29·0	
1942	Bergquist	91	43	47·2	
1946	Goldman and Johnson	71	48	67·6	
1946	Colby	19	8	42·1	
		11	4	36·3	
1944	Allen	897	51	5·7	(fatal)
1947	Britten-Jones	235	—	12·0	(fatal)

From this series, comprised of clinical and autopsy diagnoses, the range of variation is between 1·15 per cent and 69 per cent and these extremes can be used to support either contention. Illingworth and Dick (1935) state that autopsy shows the primary thrombosis in most instances to commence in the large iliac, hypogastric, and femoral veins, or more rarely in the inferior vena cava. They observe that in fatal cases the clot from the pulmonary vessel can be taken and refitted at the site of origin in the peripheral vein. No figures are given to support this statement, and the frequency of its occurrence is necessarily doubtful. Discussing this aspect, Hosoi (1932) admits that it is not always possible at autopsy to determine the origin of the thrombus giving rise to the embolism. He states that often the appearance of the clot is the only clue when it is coiled, branched, or large in size that it has come from the peripheral circulation. He finalizes his opinion somewhat hopefully by the remark: " Sometimes by reconstruction of the embolus it has been possible to surmise that a large vein was the source of the embolus ".

Davies (1935), in a series of 28 cases of fatal pulmonary embolism studied at autopsy, found evidence of thrombosis in the pelvic or leg veins in only 13 cases (46·4 per cent). Fowler (1934) in 62 cases of fatal pulmonary embolism, found thrombosis elsewhere in the venous system in only 8 cases. Barnes (1937) states: " Although pulmonary embolism is seen in cases of thrombophlebitis, there is little evidence that the pulmonary embolism arises from the thrombus of the thrombophlebitis ". He quotes Barker to the effect that thrombophlebitis of the femoral or iliac vein was found in only 5 of a total of 116 fatal pulmonary embolisms (4·3 per cent). The histological structure of these embolisms was studied in situ in the pulmonary artery in 30 cases, and evidence of organization was found only in 2 instances, and in these it was slight and confined to a very small part of the margin. Barnes, however, makes the further contradictory statement: " The situation of the thrombi which give rise to pulmonary embolism is well established ", and he goes on to quote Henderson's order of frequency of sites. These are in descending order of frequency:—

iliac vein,
femoral vein,
pelvic veins,
prostatic veins,
vena cava,
right auricle.

Hampton and Wharton (1920) remark: " Phlebitis and thrombosis of the leg veins when associated with pain and swelling are rarely ever followed by fatal embolism ", and they go further to say: " It has become almost axiomatic that of all types of post-operative thrombophlebitis, that involving the femoral and saphenous veins is the most benign, particularly when accompanied with pain and swelling. The infrequency of death from pulmonary embolism in this type of thrombosis is indeed a remarkable fact ".

Nagare (1946) echoes this sentiment twenty-six years later when he states that in thrombophlebitis lung infarcts are not so likely to occur and attempts to explain this phenomenon by postulating that the thrombus adheres to the walls of the vein. He sides with Ochsner and Homans in regarding the apparently mild clinical ' phlebothrombosis ' as a much more dangerous type of intravascular thrombosis because this characteristic of adhesion is lacking, and advocates prophylactic vein interruption in the presence of such bland thrombosis, or even when its existence is only suspected, to prevent the detachment of a friable thrombus. He quotes a series of approximately 1000 cases where this operation was practised, and says: " The results were most gratifying, because only 3 instances of fatal pulmonary embolism have occurred after ligation ". This is, however, a percentage mortality of 0·3, and is no improvement on that of Killian, who is quoted by Hosoi as reporting in 1920 that the percentage mortality of pulmonary embolism was 0·3. Goldman and Johnson (1946), who practised vein interruption in one series of 25 cases, report the subsequent occurrence of 2 pulmonary embolisms in the series (8 per cent). However, Nagare thinks: " In most instances pulmonary embolism has its origin in the veins of the calf ".

Hampton and Castleman (1940) also believe that exclusive of those emboli arising in the heart, 95 per cent of embolisms have their origin in the veins of the leg. The autopsy findings of Neuman

and Prettin, quoted by Allen, Linton, and Donaldson (1943), are supportive of this belief. The former found calf and femoral vein thrombosis in 73 per cent of embolism cases, and the latter, in a series of 144 cases, found the origin of the embolus in 133 instances (93·2 per cent) to be in the region drained by the inferior vena cava and in 91 cases the femoral and iliac veins were involved. The work of Ochsner and De Bakey (1940) and Homans (1934) has popularized the conception of a ' bland ' thrombosis or ' phlebothrombosis ' occurring with little or no clinical signs. They further stress the increased tendency of the friable thrombus of this nature to give rise to emboli as compared with the more obvious but more adherent thrombophlebitis. Such a lesion may be missed clinically, and prevent a proper assessment of the true relationship between peripheral vascular thrombosis and pulmonary embolism. Failure to examine the veins of the lower limb at routine autopsy may increaes the error of this assessment. Allen, Linton, and Donaldson are firmly convinced that this state of bland thrombosis is a common clinical entity and are advocates of vein interruption. These authors advocate bilateral operation, as in their experience unsuspected thrombosis has been found to be present in an apparently normal limb. They failed, however, in one series of 202 patients, in which unilateral or bilateral ligation was performed, to prevent completely the occurrence of further pulmonary embolism. In their series 11 cases (5 per cent) developed this complication. Whether early prophylactic bilateral ligation in all cases would prevent the occurrence of pulmonary thrombosis is open to doubt. It is significant that some of the surgeons who attribute a degree of success to this procedure also use early post-operative ambulation and in a few instances the anticoagulants, heparin and dicoumarol, as a further safeguard. In regard to early post-operative ambulation, Schenck (1913) cites the experience of Holzback, who by use of this manœuvre reduced the incidence of: " embolic and hypostatic " pneumonia from 5 per cent to 0·3 per cent. In regard to thrombophlebitis this author further instances the reduction of this complication by the Mayos from 2 per cent to 0·25 per cent by early post-operative ambulation. This experience was not universal, however, since Schenck quotes various other authorities who were not convinced that early rising affected the incidence of post-operative thrombotic states. Belt, from his autopsy findings, reports that: " probably as high as 60 per cent of the emboli arose from clotted leg veins ", and further emphasizes: " the infrequency with which venous thrombosis was recognizable clinically ".

Faxon commented somewhat similarly when he pointed out that in 128 fatal cases of pulmonary embolism clinical recognition of a peripheral thrombophlebitis was made in only 5·5 per cent of cases. Murray (1940) is firmly convinced of the causal relationship of peripheral thrombosis to pulmonary embolism and remarks: " One is impressed with the fact that pulmonary embolism is probably the strongest evidence of thrombophlebitis, and therefore its presence must be admitted even though peripheral evidence is lacking, provided the heart is normal ". Further point is given to his observation by the remarks of Schenck: " It is from the developing thrombus that emboli come, rather than from the mature thrombus, which is formed sufficiently to occlude the vein and cause symptoms ". Faxon and Welch (1941) express the generalization that one in every three cases of deep thrombophlebitis will develop a pulmonary embolism.

Cases of thrombosis occurring in the pulmonary vessels in the absence of any demonstrable lesion in the peripheral venous system are not an uncommon clinical and autopsy finding. Billings (1921) reports a series of 16 cases of primary thrombosis in the pulmonary artery which he found in the course of 6200 autopsies (0·26 per cent). In all these cases he excluded as far as possible an embolic origin. How complete this exclusion was in each case is difficult to determine unless every vein in the lower part of the body was examined, for, as Ochsner points out, the initial thrombus formation may occur primarily in such small veins as those in the sole of the foot.

Fowler (1934) reports a series of 6 cases of primary pulmonary artery thrombosis occurring in 935 consecutive autopsies (0·6 per cent). He further describes another case which is not associated with operation where the thrombus in the pulmonary vessels on histological examination was found to be well organized and adherent to the vessel walls. There was no atheromatous change in the vessel. The chronicity of pulmonary thrombosis has been stressed by other authors, especially Ljungdahl (quoted by Fowler). On reviewing more than 50 cases of thrombosis in the pulmonary artery the histories of which were given by Fowler, it was found that some of the patients had symptoms almost certainly due to pulmonary thrombosis present for periods varying from one to five years. Fowler reviews the possible role of syphilis, arteriosclerosis, and pulmonary tuberculosis as precipitating factors acting locally in the development of pulmonary thrombosis and was not convinced that any real relationship existed. Fotheringham (1929) reports a case of spontaneous development of thrombosis in the smaller branches of the pulmonary arteries. These thrombi propagated centripetally towards the heart. Multiple small infarctions of varying ages were present in the lung. Hosoi remarks that " the primary site of the thrombus may occur anywhere in the venous circulation. It may even be primary in the lung itself ".

Whilst it is admitted that an embolism may occur in any branch of the pulmonary arteries, it is common clinical experience that the great majority occur in the vessels to the lower lobes. Allen, Linton, and Donaldson have tabulated the distribution in their series (*Table II*). Thus a total of 96·3 per cent occurred in the lower lobes. In a later reported series, the tabulated distribution was approximately similar.

Table II.—Location of Pulmonary Emboli

Site	*Cases*	*Percentage*
Left lower lobe	66	59·4
Right lower lobe	41	36·9
Left upper lobe	3	2·7
Right middle lobe	0	—
Right upper lobe	1	0·9

Hampton and Castleman (1940), in their series, found that 43 per cent occurred in the right lower lobe, 31 per cent in the left lower lobe (74 per cent in the lower lobes). The remaining 26 per cent were distributed evenly through the rest of the lung. Attempting to explain this constant distribution, Allen, Linton, and Donaldson state: "This is thought to be due to the anatomic arrangement of the pulmonary circulation, and the fact that the blood-flow is more rapid through the lower than the upper lobes. An embolus, for this reason, will be carried by the swiftest current to lodge most frequently in the left and right lower lobes".

This is a reasonable presumption when considering the case of an embolus, but when primary local thrombosis is considered the element of pulmonary circulatory stasis is of importance. Best and Taylor (1939) point out that the inspiratory decrease of the intrapleural pressure is greater at the lung bases

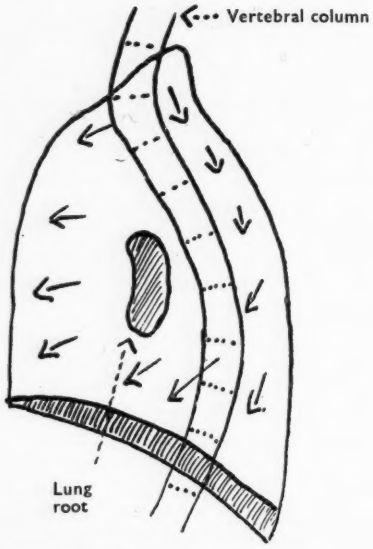


FIG. 383.—Showing direction of inspiratory movement in different portions of lung. (*After Keith, from Best and Taylor.*)

than at the apices or lung roots. Furthermore, they state that the direction of the inspiratory movement in the different portions of the lungs has been shown by Keith (*Fig.* 383) to be away from the apex, and they remark: "The restricted expansion of the air sacs at the apex . . . has been held responsible for their being the primary site of tuberculous infection". These three factors of differential pressure, direction of respiratory movement, and variation in aeration between the apex and bases, may provide a physiological explanation for the phenomenon.

The anatomical course of the pulmonary vessels provides further evidence to support a more readily accessible pathway for an embolus to the lower than to the upper portions of the lung. Robb and Steinberg (1939) made contrast radiographs of the pulmonary vessels in the living subject and demonstrated the larger calibre in the vessels of the lower lobes. From the viewpoint of primary thrombosis the effect of stasis would also be more marked in these areas, as the course of most of the major vessels is not only downwards but also backwards.

Hosoi (1932) comments on the fact that the right pulmonary artery is larger than the left as a possible explanation for the greater number of embolisms occurring on the right side. In his series 42 per cent occurred in the lower lobes and the ratio was two on the right to one on the left. He quotes Miller as finding the proportion of right to left to be five to three.

PERIPHERAL VEIN INTERRUPTION

Acting on the assumption, which is far from proved in the literature, that the majority of pulmonary thromboses are of embolic nature arising from thrombi in the peripheral venous system, many surgeons are advocating ligation of the veins of the legs in an effort to prevent lung involvement. The most active protagonists of this practice belong to what Homans calls "the Boston School".

Allen, Linton, and Donaldson put the present position in regard to therapy very clearly: "There are two concurrently competitive programs of treatment; ligation of veins and the use of anticoagulants, heparin and dicumarol. Neither program of treatment is generally considered superior to the other, although each has its proponents who see little virtue in the other". Their special work has been done in the field of vein interruption. They dismiss the conservative measures with which the mortality of pulmonary embolism was reduced to 1 in 800 surgical cases as not completely adequate, thus: "Even this did not eliminate the terrific morbidity with which we were confronted since all conservative measures of treatment of thrombophlebitis at our clinic included a prolonged period of bed rest and immobilization". They further emphasize the relative apathy to the condition from an active therapeutic viewpoint by saying: "Until recently, intravascular thrombosis and its consequences have been considered largely inevitable". These authors reported a series of 202 cases in which vein interruption was carried out for thromboembolism. As the operation is performed essentially to reduce the incidence of lung lesions, complications arising from embolisms from the peripheral veins, their results are of interest (*Table III*).

Table III.—VEIN INTERRUPTION FOR THROMBO-EMBOLISM. DETAILS OF 202 CASES

	Thrombus found at Operation	*Thrombus not found at Operation*
Patients with infarcts	30 (35·7 per cent)	54
Patients without infarcts	56 (47·4 per cent)	62

If one believes with such authorities as Hampton and Castleman that more than 90 per cent of lung lesions arise from thrombus in the leg veins, these results are disturbing. The somewhat hopeful explanation given by Allen and his co-workers that where thrombus was not found in the leg veins at operation in cases of pulmonary infarction "the thrombus or portion of it has either left the leg vein or is still in the lower veins of the leg", is not adequate. The description by Billings (1921) and

others of primary lung thrombosis, and the failure to find leg lesions in many instances at autopsy as reported by Fowler, Davies, Barker (1940), and many others, lends point to this objection. Furthermore, in this series of 202 cases there were 11 instances of pulmonary embolism occurring after ligation of the veins. These authors describe a further series of 33 cases in which femoral vein ligation was practised. Infarction was present in 18 cases at the time of operation. One case developed a further pulmonary embolus after operation. Reviewing the results of this series the authors state that from their previous experience they should have expected five infarcts and one death if ligation had not been practised. This interpretation may not be wholly acceptable if we believe Hampton and Wharton's (1930) estimation that only 10 per cent of pulmonary embolisms show recurrence. Of the 33 cases 18 already had infarctions before ligation, so that at the most, on this basis of calculation, only 2 would have had further infarctions if ligation had not been practised. Furthermore, taking the incidence of 18 cases of embolism in a series of 33 cases of thrombophlebitis, the incidence (54·5 per cent) must represent saturation point in the relationship of these two disorders. It is possible to speculate even further that the embolus which did occur after operation may have been due to dislodgement of thrombus at operation or formation of new thrombus at the operative site. In a more recent series, Allen describes 9 cases of pulmonary embolism (of which 3 were fatal), following upon ligation of the peripheral veins in 39 cases of pulmonary embolism. It was his feeling that in 5 of these 9 the emboli arose in the apparently normal leg which was not ligated. This still, however, leaves 4 cases with lung lesions occurring after the leg thrombus had been isolated by ligation. Allen and his co-workers are inclined to advocate bilateral femoral vein ligation. They remark: "As a matter of fact, we have found thrombosis in so many supposedly normal extremities that we are inclined to feel that the simultaneous routine interruption of the opposite vein should be undertaken".

The experience of recurrent embolism or lung thrombosis after ligation is generally reflected in the literature. Goldman and Johnson (1946), in 25 cases, had 2 develop a pulmonary thrombosis. In a further case of these authors, death occurred from the dislodgement of a thrombus at operation. Colby (1946) had four fatal pulmonary embolisms in 428 prostatic operations, where early ambulation and, in selected cases, vein ligation was performed. A general survey of the literature shows that wherever vein interruption for peripheral vascular disease is practised, there is an apparent reduction in the morbidity and mortality. But little evidence is produced that the procedure constitutes a guarantee of immunity to the patient.

The factors which may operate to produce embolism or thrombosis in the lung vessels after ligation of the peripheral veins may be any of the following:—

1. Embolus arising from opposite unligated leg.
2. Embolus arising from thrombus developing at the site of vein ligation.
3. Failure to occlude the vein proximal to the thrombus.
4. Dislodgement of a thrombus from the vein during operative manipulation.
5. Embolus arising from other sites such as the arm, pelvic veins, or heart valves.
6. Primary thrombosis in the lung vessels.
7. Further extension of a pre-existing pulmonary thrombus, the existence of which may not have been known.
8. Embolism from the collateral circulation of the involved limb.

The indications for the operation of vein interruption at present advocated are:—

a. Pulmonary infarction or embolism.
b. Tenderness over the leg veins.
c. Dilated superficial veins of the legs.
d. Œdema of the legs, however slight.
e. Discomfort in the calf.
f. Elevation of the temperature and pulse which cannot be satisfactorily explained.

In addition, the procedure is advocated as a prophylactic measure in patients beyond the age of 40 years who are to undergo surgery. Where a history of previous thromboses or where varicose veins are detected, prophylactic ligation is advocated. That these indications are being more widely applied each year is seen from the following table of Allen, Linton, and Donaldson (*Table IV*).

Table IV.—Femoral Vein Interruptions per Year.

Year	*Number*
1937	1
1938	0
1939	8
1940	5
1941	55
1942	211
1943	299

These figures are a reflection of the work in many other clinics, although few appear to have done such a large series of cases.

Dislodgement of a thrombus by operative manipulation is not a theoretical occurrence. Goldman and Johnson (1946) report such a case with a fatal outcome. Allen and others have not had this complication. These authors state that femoral vein occlusion has not been responsible for a single death in their experience. The possibility of a cul-de-sac being left at operation, and because of venous stasis in association with the line of endothelial damage at the site of ligation developing a thrombus therein, cannot be overlooked. This may propagate into the venous stream and give rise to embolism.

Residual swelling may occur but is described by most authors as being of short duration. When the procedure is carried out as a prophylactic measure or early after the development of leg thrombosis, the œdema is transient as the collateral circulation develops adequately, but when an obstructive state is well established, the recovery is of longer duration and of varying completeness. Ligation or vein interruption does not dispel vasospasm. The follow-up of Goldman and Johnson in 43 cases where the ligation was performed at different sites shows the percentage

of patients still with œdema on leaving hospital (*Table V*).

Table. V—FOLLOW-UP DETAILS OF 43 CASES IN WHICH LIGATION WAS PERFORMED.

SITE OF OPERATION	CASES	RESIDUAL ŒDEMA	PER-CENT-AGE	COMMENTS
Superficial femoral vein	33	6	18	Minimal at ankle
Common femoral vein	5	2	40	Moderate to minimal
External iliac vein	4	2	50	Moderate
Common iliac vein	1	1	100	Moderate

These authors remark that ligation of a patent vein with open collaterals does not produce œdema. They further advocate that thrombectomy associated with vein interruption further reduces the incidence of œdema. They stated that in the observed series the œdema was progressively diminishing under observation.

Allen, Linton, and Donaldson remark: "Both early and late œdema of the legs are greatly influenced by the extent and duration of the thrombosis prior to thrombectomy and vein interruption". They prefer operation at the site of the common femoral.

Homans (1934) advocates ligation of the common iliac and presents some excellent anatomical evidence that this is the most advantageous site as the greater number of contributory veins enter the main trunk between the level of the femoral and common iliac vessels. He refers to œdema following ligation of the inferior vena cava: "It is proper to say, however, that in the observation of a dozen or so cases of division of the vena cava of which I have knowledge (unpublished observations), the subsequent venous return from the legs has been remarkably satisfactory, and no serious after effects have yet been observed".

It is interesting to recall the observations of Schenck, who in 1913 quoted the late histories of 29 cases of crural thromboses, from the point of view of residual swelling. In 8 instances recovery occurred after 4 months and in 2 after 1 year. Recovery did not occur in 19 patients. He states that thus 65 per cent never completely recover normal limbs and that in those who do the recovery may take up to one year. If the results of early or prophylactic ligation are shown in time to confirm the present optimistic view, then not only may it serve to prevent embolism to some degree, but it may be used as an active therapeutic measure to eliminate the residual pain and swelling so commonly consequent upon leg thromboses. The development of indolent leg ulcers is not uncommon after leg thromboses. These are notoriously resistant to treatment and it may be that early vein ligation will serve to prevent this complication.

The experience of Levan (1946), however, does not give rise to undue optimism in this regard. Discussing ligation of the femoral vein this author remarks: "In addition to its inadequacy, it carries a morbidity in the form of œdema which in a series of 202 cases was immediate in 47·5 per cent and late in 42 per cent".

If ligation is to be practised the vein must be interrupted proximal to the upper limit of the thrombus or the procedure is without point. To decide this level in any given patient is often extremely difficult, if not impossible. The occurrence of thrombus in an apparently normal limb had been stressed by Ochsner, De Bakey, Allen, Homans, and many others. If, then, the existence of the condition cannot be clinically recognized, to attempt an estimation of its extent is purposeless. Approximately half of the patients developing intravascular thromboses first show the symptoms of the condition in the chest. In Hampton and Wharton's series (1920), infarction was the first manifestation in 43 per cent of cases, and leg thromboses in 57 per cent. In the series reported by Allen and his co-workers, chest symptoms occurred first in a similar frequency. To decide the site of ligation in such cases is difficult. The tendency is to perform bilateral ligation at a site routinely preferred by the individual surgeon. In most instances this is chosen at the superficial or common femoral veins. In such obvious cases as those showing œdema to the knee or to Poupart's ligament the problem still is not simple because the upper limit of the thrombus may be in the common iliac veins in both instances. Even when the disease appears unilateral clinically, ligation is purposeless if early thrombus formation is occurring in the opposite limb. For this reason ligation of the inferior vena cava would theoretically be the ideal operation, providing experience shows the procedure to be as innocuous as Homans prophesies. The next most adequate site is the common or external iliac veins as preferred by Homans. The disadvantage of requiring abdominal incisions and of being technically a more difficult procedure appears to influence most surgeons against these sites in preference to operations on the femoral veins below Poupart's ligament. There appears to be no difference of opinion in regard to ligation of the saphenous veins when these show early involvement with the disease. It is to be remembered that these procedures all involve one, or more usually, two additional surgical incisions and that they may not always be simple operations of short duration, and although apparently minor procedures in the hands of experts, will certainly be of major nature when performed by the 'occasional' operator. With widespread popularity of the technique the integrity of the arteries will be in considerable jeopardy and the possibility of arteriovenous aneurysm cannot be overlooked. Grave consequences follow damage to the arterial supply of the limb.

A NEW CONCEPTION OF THE FACTORS CONCERNED IN INTRAVASCULAR THROMBOSIS

The conditions predisposing to the development of intravascular thrombosis will be discussed from two aspects. First, the demonstrations of a 'prethrombotic state' as demonstrated by the use of the post-operative coagulation graph, and, secondly, the estimation of the presence of free fibrinogen B in the plasma.

DEMONSTRATION OF THE 'PRETHROMBOTIC STATE'

Bergquist (1940) stated that prior to the onset of intravascular thrombosis a tendency of the blood to clot more readily was present. This he termed the 'prethrombotic state', and he found that it could be detected for periods varying up to 12 hours prior to the onset of thrombosis. He advocated the use of regular post-operative coagulation-time estimations for its detection. He furthermore found that the use of heparin during this state would avert the onset of thrombosis and that only small quantities of heparin were required. It was apparent that if Bergquist's findings were accurate the use of this method would detect those patients in whom intravascular thrombosis was about to occur and the administration of heparin prevent its onset. However, the technique for estimating the coagulation time used by Bergquist required daily venepuncture, and so it was decided to see if the much less laborious technique of finger puncture and capillary tube estimation of coagulation time could be substituted without detracting from the value of Bergquist's work. In cases of primary thrombosis this was found to be so, and in no case did a prethrombotic state occur without being readily detected.

Bergquist regarded 3 minutes as the danger level when his technique is used and there appears to be no loss of value when the capillary tube finger-prick is employed. It is stressed, however, from the experience gained in this investigation that 4 minutes should be regarded with suspicion in this country when the test is performed in the manner suggested. A time of 4 minutes by itself is of no significance, but when the coagulation time falls below this and remains consistently in the order of 3 minutes or less when repeated at hourly intervals, the occurrence of a prethrombotic state is established. The essential point in the diagnosis of this condition is the fixation of the graph at the level of approximately 3 minutes. An attractive feature of the capillary tube finger-prick technique is the fact that it can be carried out by the nursing staff, after a little preliminary instruction, as a routine, and this in itself makes it more widely applicable than Bergquist's original technique.

The Compilation of the Post-operative Coagulation Graph.—"The coagulation time is the time which the blood takes to clot after it has been shed" (Best and Taylor, 1939). Various methods have been described for the clinical determination of this time. The more common ones are the use of a running drop of blood on a platinum loop, the detection of gel formation by the inversion of blood in test-tubes, the arrest of lead shot when solidification of the blood occurs, and the cessation of mobility in a drop of blood upon a glass slide. These techniques may be carried out at room temperature or at 37° C. However, the most commonly used method and the one which has been employed in this study is that known as the capillary tube technique. A needle puncture of the finger is made and a drop of blood expressed. This is drawn into a capillary tube about 4 in. long. By breaking off small segments of the tube at minute intervals the appearance of a fine thread of blood-clot indicates that coagulation has occurred. The coagulation time is that period from when the blood is shed on the finger until the thread is detected. Best and Taylor remark that this method "... is probably just as accurate as more elaborate procedures". The normal coagulation time by this method is stated to be 4 minutes. Certain points of technique were adhered to in this study:—

1. The finger was always allowed to dry if any cleansing agent was used before making the puncture. Some thousands of tests have been carried out and in no instance has any soreness of the finger, even of minor degree, resulted. There has not been any case of infection developing.

2. The index finger and thumb were never used in case infection should develop.

3. The site selected was always the edge of the finger just outside the lateral fold as this is much less sensitive than the pulp.

4. The finger was never rubbed vigorously as this may cause capillary damage, with the release of thromboplastin.

5. The first drop of blood expressed was used, and where it was not of sufficient amount the test was repeated on another finger, as it was considered that expressing a second drop through the same puncture might give rise to false readings because of excess thromboplastin remaining from the first drop.

6. The test was carried out at room temperature. The possibility of very hot or very cold days affecting the qualitative value of the test appeared from experience to be a theoretical consideration only, as many patients were done together and a wide variation was always present. For instance, although a general tendency for the coagulation time to be short on very hot days as compared with cold was noticed, there was always a marked variation in the tests done at the same time on different patients.

7. A small segment of tube was broken off at minute intervals until coagulation occurred. When this was apparent before 4 minutes the test was repeated and segments broken off at ½-minute intervals, as it was important to know if coagulation occurred just after 2 minutes or just before 3 minutes, or just after 3 minutes or just before 4 minutes. Where coagulation did not occur until after 4 minutes, intervals of 1 minute were considered satisfactory. It was considered unnecessary to increase the technical difficulties of the test by carrying out the readings at a standard temperature, as the lower coagulation times were the ones of significance and the margin of error did not materially effect the clinical value of the test, which is essentially qualitative rather than quantitative. In many instances the readings showed a marked variation and in others the coagulation times tended to remain at a relatively constant level. Providing a definite sustained fall in the coagulation times did not occur both these forms of graphs were regarded as normal.

When the tests were carried out at a constant temperature of 37° C. the readings were more consistently maintained, but where this technique was not pursued a wide fluctuation of the times was often more apparent. However, in spite of the

academic objections to this technique the apparent error due to daily temperature variation appeared not to affect the detection of the phase of lowered coagulation times when the graph of the patient under consideration was compared with graphs of other patients compiled concurrently, and as one of the essential objectives in this study has been to utilize the simplest method for routine use the technique was persisted with. Except in certain institutions, such methods as require frequent venepuncture to obtain a specimen are not administratively workable. If, however, the essential aim

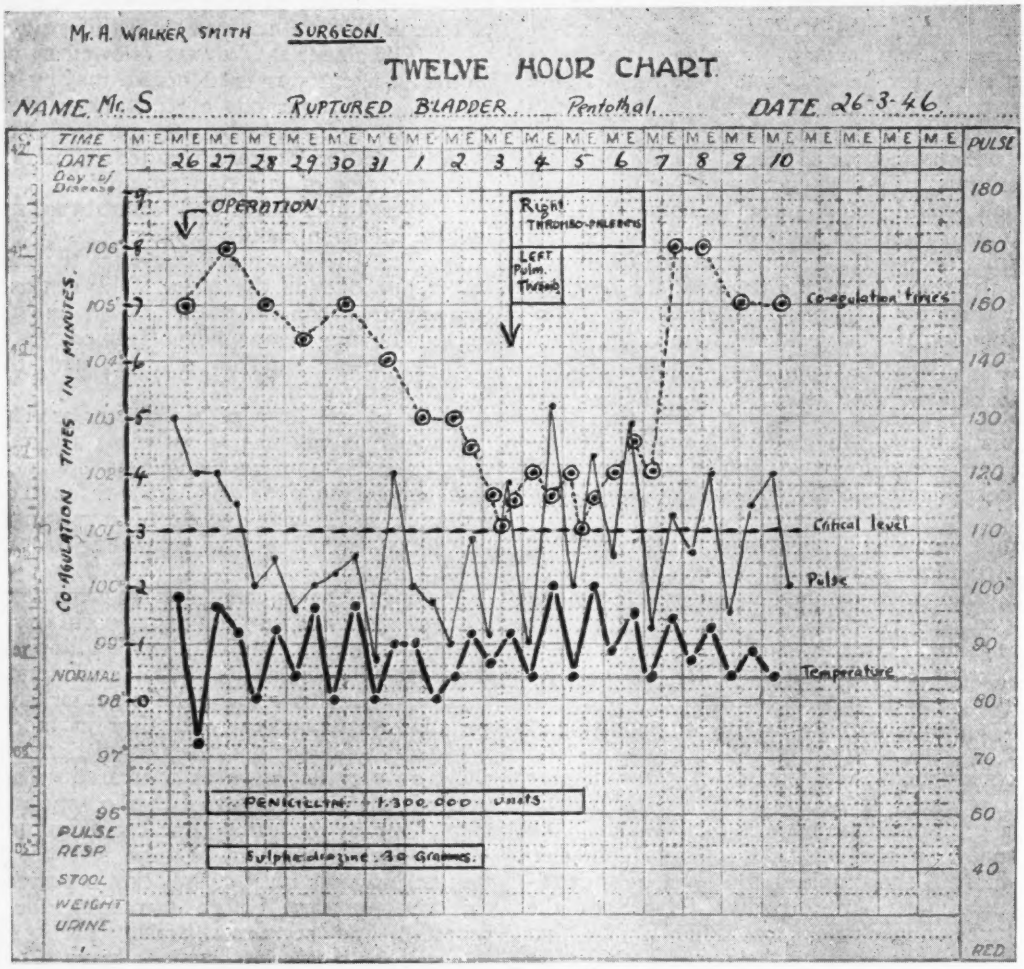


FIG. 384.—The steady decline of the coagulation graph is seen in combination with the persistence of a low-grade pyrexia. A tachycardia of the *Treppenpuls* type is well illustrated. As expected, the presence of these three signs culminated in an intravascular thrombosis.

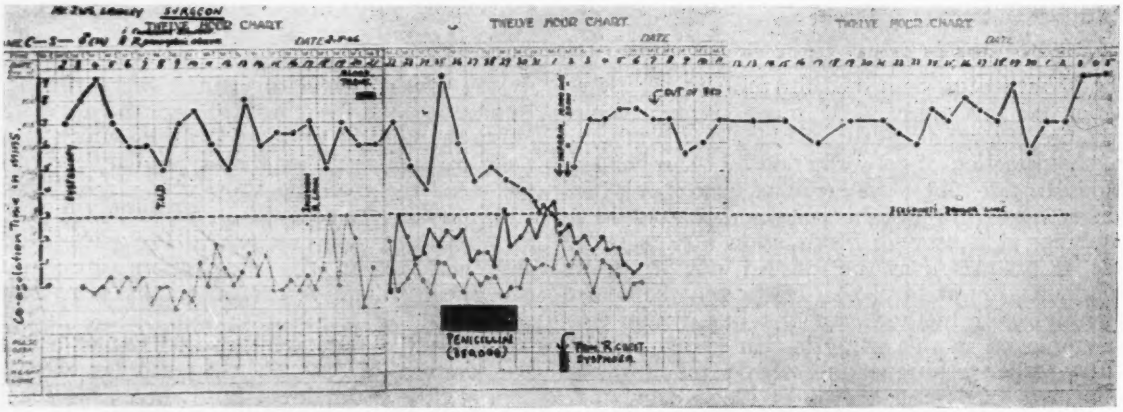


FIG. 385.—This graph again illustrates a prethrombotic state in a case showing persistent pyrexia and an increasing pulse-rate suggestive of *Treppenpuls*. A classical pulmonary infarction developed.

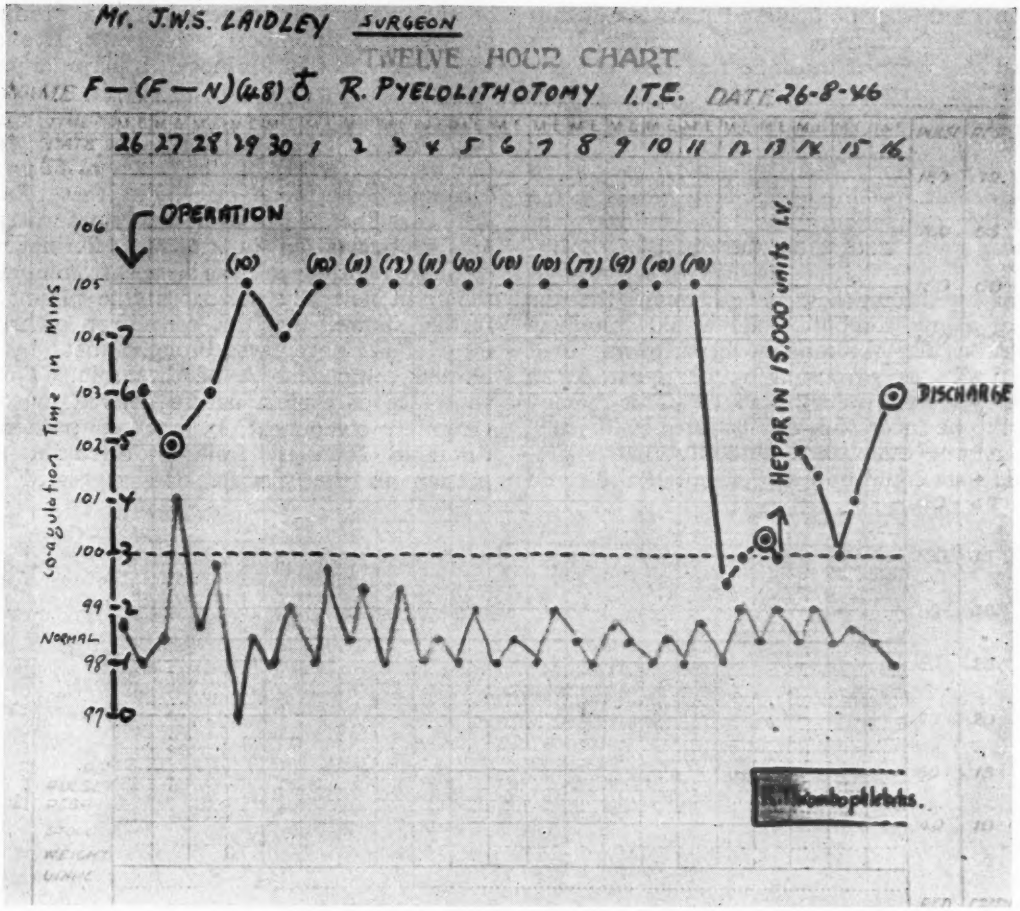

Mr. J.W.S. LAIDLEY SURGEON
TWELVE HOUR CHART
F—(F—N)(48) ♂ R. PYELOLITHOTOMY I.T.E. DATE 26-8-46
26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
OPERATION
(10) (10) (11) (13) (11) (10) (10) (10) (11) (9) (10) (10)
HEPARIN 15,000 units I.V.
DISCHARGE
Co-agulation Time in Mins.
NORMAL
Thrombophlebitis.

FIG. 386.—This is a classical example of a prethrombotic state developing n association with a persistent low-grade pyrexia and culminating in an intravascular thrombosis. Further studies were impossible in this case as the patient refused to remain in hospital. There was no significant tachycardia.

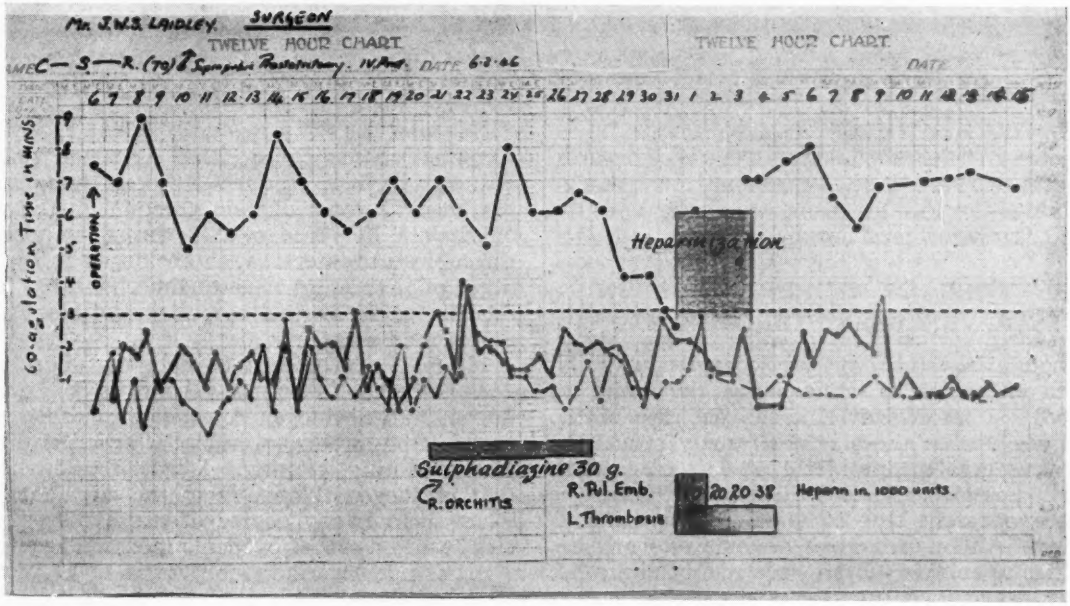


FIG. 387.—This case illustrates a persistent infection with the development of a prethrombotic state culminating in the simultaneous onset of thrombosis of the lung and leg.

—to demonstrate a sustained depression of the coagulation time—can be achieved by a test within the capacity of the nursing staff to perform, from the clinical viewpoint it must be regarded as satisfactory for the purpose.

8. As near as possible, a standard bore capillary tube was used.

Four illustrations (*Figs.* 384–387) are given wherein a definite prethrombotic state was detected by use of the coagulation graph. No anticoagulant therapy was given until after the onset of thrombosis.

As it appeared from these and other cases that the presence of a prethrombotic state would culminate in an intravascular thrombosis, heparin was used prophylactically, as advocated by Bergquist, in an endeavour to avert this complication. This therapy was found to be successful, as illustrated in *Fig.* 388.

Once it was established clinically that a prethrombotic state could not only exist, but also could be detected and then modified by the use of heparin, an effort was made to determine the possible relationships of the prethrombotic state and the normal coagulation mechanism.

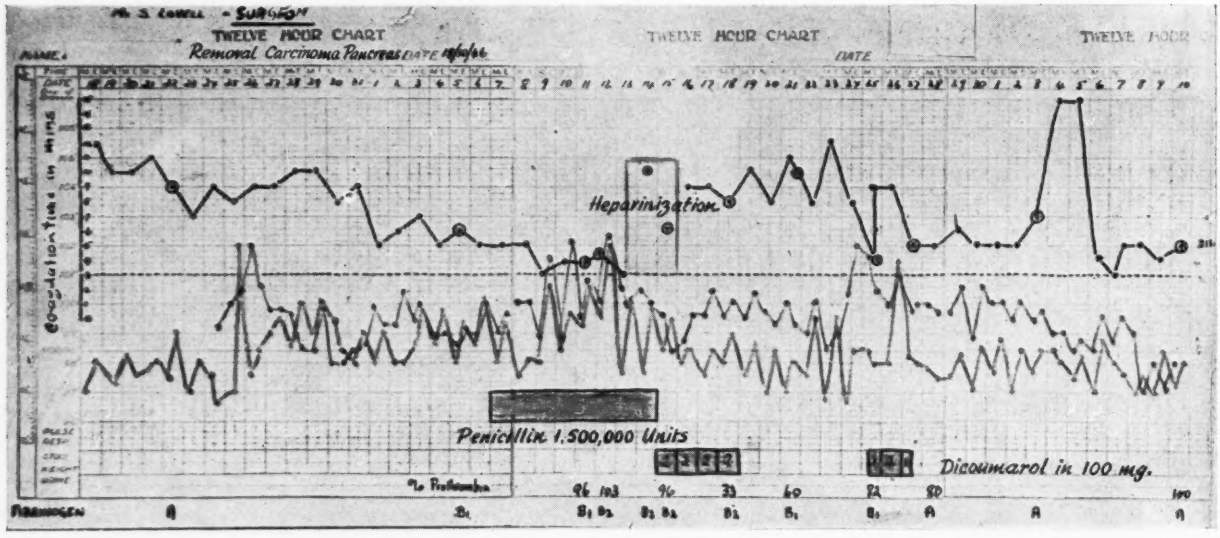


FIG. 388.—The steady decline of the coagulation graph is well demonstrated. A persistent pyrexia was present and a phase of exacerbation simultaneous with the prethrombotic state is apparent. A tachycardia of the *Treppenpuls* type is well marked. Heparin was used prophylactically in this case and the coagulation times returned to a higher level. It is felt that an intravascular thrombosis was averted.

THE ROLE OF FIBRINOGEN B IN INTRAVASCULAR THROMBOSIS

Although the use of the coagulation graph provided a means of anticipating the onset of thrombosis, it is evident that the decrease of the normal coagulation times is not by any means the whole answer to the problem. A low coagulation time will not give rise to intravascular thrombosis and it is apparent that some additional factor is operative. Although a great amount of work has been done upon this subject little real headway has been made, and apart from the reported observations of an increase in the number and 'stickiness' of the blood-platelets and an increase in fibrinogen following operation there did not appear to be any special evidence to support a particular role for any of the plasma constituents in the production of intravascular thrombosis. However, Lyons (1945), who suggested that fibrinogen B played a part in the normal blood-coagulation mechanism, later became interested in its role in intravascular thrombosis (*see Part II*). He had demonstrated previously that the conversion of fibrinogen to fibrin was not accomplished in one stage, but that thiol groups were first liberated from naturally occurring fibrinogen producing an intermediate fibrinogen. This he termed fibrinogen B, as distinct from fibrinogen A, the form normally present in the plasma. Lyons further showed that this conversion of the A to B form of fibrinogen was brought about by what he termed component A of thrombin. This was a substance of protein nature derived together with thrombin component B, another portion of the thrombin complex, from prothrombin which is present in the plasma. He suggested that the thrombin component B either contained vitamin K or that vitamin K produces a protein complex which has an oxidation-reduction potential in the vicinity of vitamin K. The role of this B component of thrombin is to interact with fibrinogen B to produce fibrin gel in the normal clotting mechanism. Lyons's scheme for the normal coagulation of blood may be represented diagrammatically as in *Fig.* 389.

It is of importance to note that fibrinogen B does not occur in normal plasma, as it is only produced from fibrinogen A when thrombin has been formed from prothrombin by the action of thromboplastin during clotting. Lyons found, however, that fibrinogen B appears in the circulating blood when there is any degree of tissue necrosis, especially when a site of pyogenic infection is present.

It is not necessary for pyrexia to be present in states of chronic infection. Such clinical examples may be cited as syphilis, chronic gonorrhœa, apical dental abscess, chronic otitis media, maxillary sinusitis, and chronic cervicitis. The presence of

such a condition appears adequate to cause the formation of fibrinogen B from the fibrinogen normally occurring in the plasma in many patients. Operation with its tissue damage or parturition giving rise to the placental site and the tissue destruction consequent upon involution of the uterus provides a ready source of thromboplastin. This is augmented by the re-adsorption of extravasated blood, the necrotic ends of ligated or diathermied vessels and of foreign bodies such as catgut.

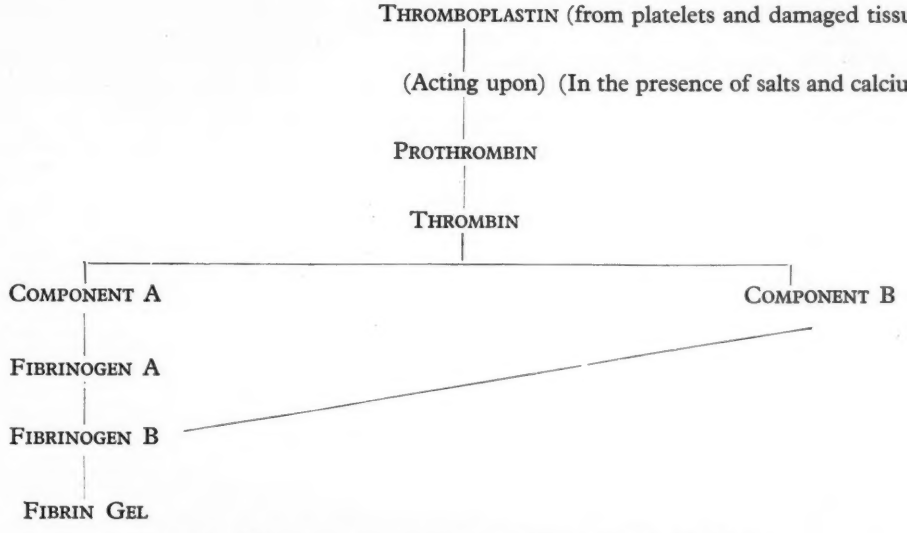


FIG. 389.—Diagrammatic representation of normal coagulation of blood.

The role of cardiac failure and venous stasis appears to be of major importance in determining the site for the onset of the thrombosis. Should small amounts of fibrin gel be formed an active circulation prevents this settling down locally in any vessel and may aid in its destruction mechanically against the vessel walls and at their bifurcations (as in the case of the red blood-cells). It is probable that, in addition, the leucocytes, which are always seen prominently in early thrombus formation, also aid in the destruction of the gel, and that the ferment fibrinolysin also plays a part. When, however, an individual in whom the plasma contains free fibrinogen B is confined to bed for a prolonged period (or in whom venous stasis develops from some other cause) the effects of venous stasis become apparent. The platelets come in contact with the vascular endothelium and should any degenerative changes occur in this, as may result from anoxæmia, they will disintegrate and release thromboplastin locally. This gives rise to the formation of thrombin and the resultant fibrin clot cannot be disintegrated if an adequate circulation is not maintained. The sites where venous stasis is most apparent in the recumbent patient are the great vessels of the legs and lung bases. Blood-clotting may then occur upon the initial thrombus which acts as an intravascular foreign body. The classical finding of the white and red portions of a thrombus is illustration of this. Such a quiet process is not associated with local infection necessarily and the resultant pathological condition is the bland 'phlebothrombosis' as described by the Boston School. Because of the nature of its production, the thrombus is friable and not adherent to the vessel walls. It is not necessary to modify this process greatly to produce the more evident clinical thrombophlebitis. A spreading infection from the surrounding tissues such as is seen in uterine infection or following a local skin ulcer or abscess, or a bacteræmia of a low-grade nature, would appear sufficient for this change. Both conditions may well coexist and a patient may have an obvious thrombophlebitis in one leg and yet die from an embolus arising from an unsuspected bland phlebothrombosis in the other apparently normal leg. Such cases, however, are not necessarily of embolic nature, but the pulmonary extension may well be due to the primary formation of further thrombus in the lung vessels. In this connexion there is a growing conviction in the minds of clinicians that many of the immediate post-operative 'pneumonias', 'pleurisies', and 'bronchopneumonias', are really manifestations of this condition.

Cases studied at the Royal Prince Alfred Hospital indicated that intravascular thrombosis may become manifested in three distinct ways in relationship to the appearance of free fibrinogen B in the plasma of the patient. These are illustrated in *Figs.* 390–392.

Thrombosis may occur within a short period of operation even in the absence of pre-existing fibrinogen B. This is due to the production of excess amounts of thrombin (*see* later).

Once thrombosis has occurred in the legs detachment of fragments may produce pulmonary embolisms quite independently of the presence or absence of fibrinogen B in the plasma at this time. The impression was formed, however, that such emboli are usually small and do not cause death unless fibrinogen B is present, in which case rapid clotting may occur throughout the pulmonary vessels as a secondary phenomenon upon the small initial true embolus. Autopsy findings on such cases where death has occurred usually show the small initial embolic thrombus with a long tail of

fresh red clot. This latter is the lethal factor and there is usually some time interval before its development. The use of the anticoagulant drugs can prevent the development of this secondary clot,

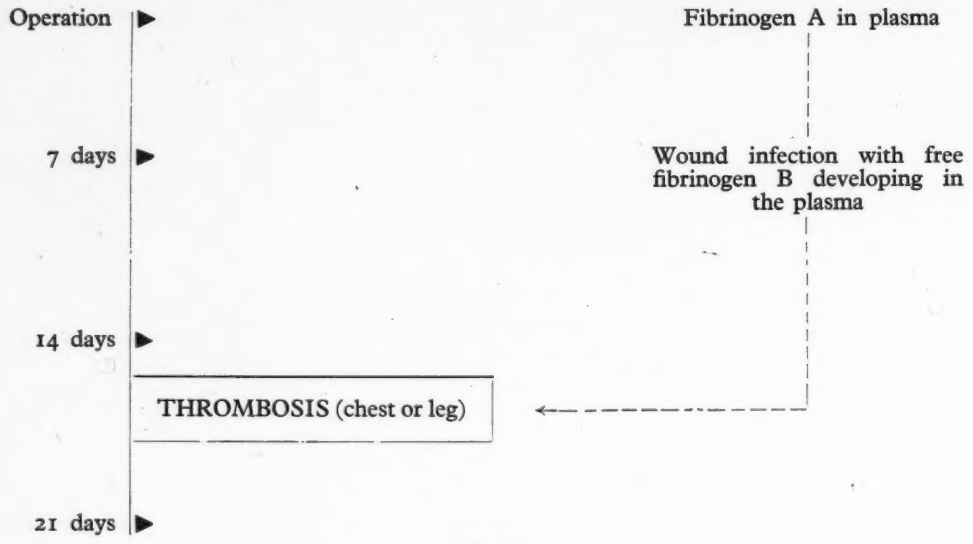


FIG. 390.

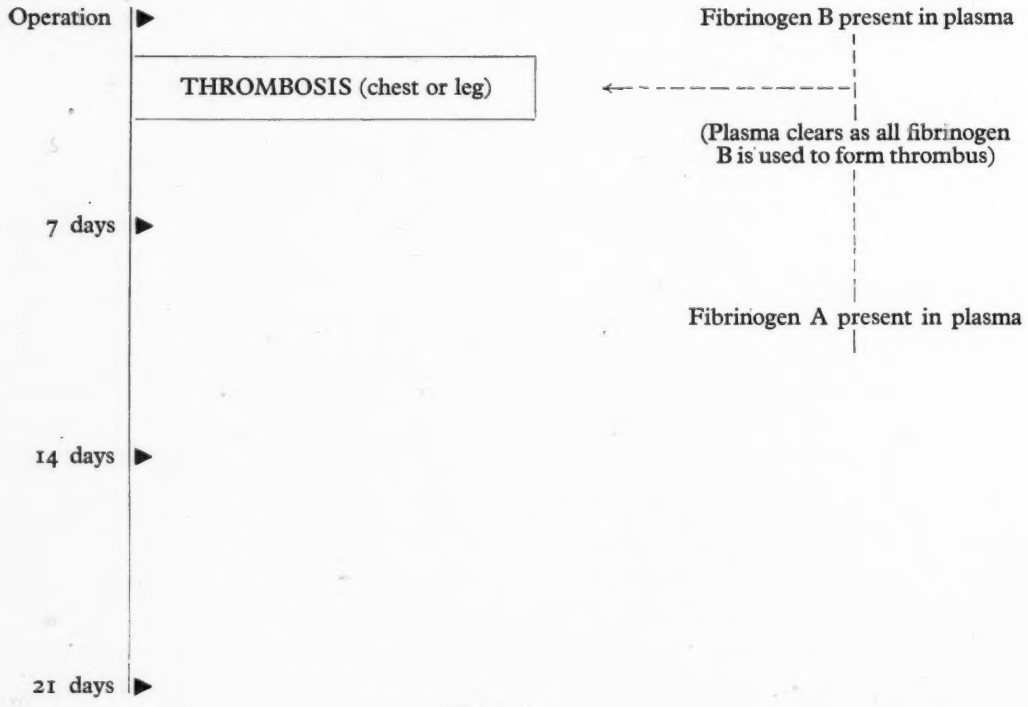

Operation
7 days
14 days
21 days
Fibrinogen B present in plasma
THROMBOSIS (chest or leg)
(Plasma clears as all fibrinogen B is used to form thrombus)
Fibrinogen A present in plasma

FIG. 391.

and they should be used for as long as fibrinogen B is found to be in the plasma. Once an intravascular foreign body is present, in this case the initial thrombus, it is not necessary for the coagulation times to be low for the secondary clotting to occur and so in these cases the plasma-fibrinogen findings are far more important than those of the coagulation graph. The evidence that the long clots, sometimes coiled, which are found in the pulmonary vessels, are always of embolic origin from thrombosis of the legs is not completely convincing. If such is the real site of origin it is a remarkable fact that they do not obstruct the proximal end of the inferior vena cava in a percentage of cases at least, and that they appear successfully to negotiate a passage through the various cardiac chambers and even succeed in passing up each limb of the pulmonary bifurcation. The experiences of Murray (1947) are of extreme interest from this viewpoint. In one series of 371 cases of established leg thrombosis treated with anticoagulants there was not one instance of a pulmonary thrombosis

developing. It is hardly possible in so large a series for such complete protection to be afforded against the mechanical detachment of fragments from the leg clot. It is suggested that the anticoagulants prevented the development of primary lung thrombosis in these cases as they could not reasonably be expected to produce such dramatic results were embolism as common as is thought. Further point is added to this argument by the report by Murray of a series of 149 cases of what he terms pulmonary embolism which were treated by anticoagulants. Although many of these patients were *in extremis* when treatment was begun, no deaths occurred. The action of the anticoagulants in preventing further extension of the clotting process was no doubt the reason for this. However, no such action could reasonably be expected to save a patient in whom a massive peripheral clot had become detached and passed to the pulmonary vessels. Such a problem is mechanical. On the other hand, if the lethal factor is local extension, either on a primary lung vessel thrombus or upon a small fragment from the leg veins, then the amazing action of the anticoagulants in preventing death is readily understandable.

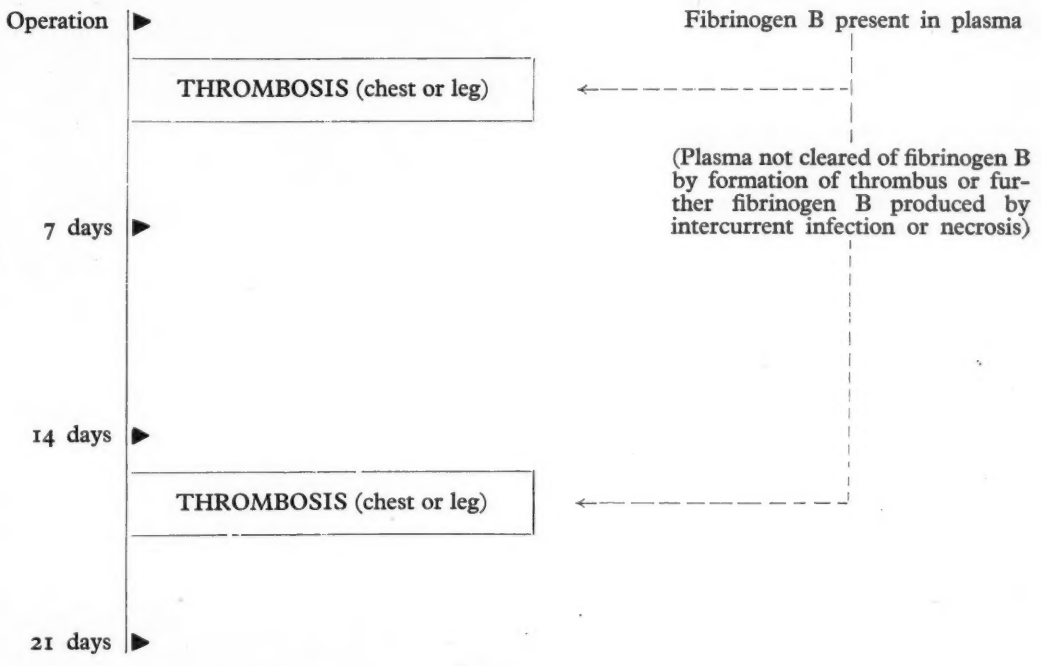

Operation
Fibrinogen B present in plasma
THROMBOSIS (chest or leg)
(Plasma not cleared of fibrinogen B by formation of thrombus or further fibrinogen B produced by intercurrent infection or necrosis)
7 days
14 days
THROMBOSIS (chest or leg)
21 days

FIG. 392.

It is suggested that the development of a primary thrombosis in the lung vessels is more frequent than is supposed and that major pulmonary embolism is less common. The factors of venous stasis and plasma-fibrinogen B can operate in the large vessels of the lung bases equally as well as in the big venous trunks of the legs. Considerable effort has been expended trying to prove that pulmonary thrombosis is always embolic. Even the most enthusiastic advocates of this conception, who regard the primary condition as being present in the legs in 90 per cent of the cases, leave unexplained the other 10 per cent. Many of their reasons are speculative. It is frequently found that pulmonary thrombosis occurs before the onset of a leg thrombosis and in many cases in its absence, and, as the great majority of patients do not die, little factual evidence can be produced to prove that the pulmonary condition was embolic. The fact that the clinical symptoms of pulmonary thrombosis are of an acute nature is regarded by many as proof that the condition is embolic, but it is doubtful if this explanation is adequate. The onset of symptoms is most probably governed by the occurrence of vascular spasm. There seems to be no essential difference between the spasm arising from the sudden lodgement of an embolus in a vessel of such small calibre as to prevent its further migration and that arising upon a locally developing thrombosis which finally reaches sufficient size to excite vasospasm. It is frequently found at autopsy that the thrombus is not of sufficient size to occlude the lumen of the vessel. Careful questioning of the patient usually reveals that the suddenness of onset is more apparent than real. Many complain of a feeling of 'oppression' in the chest, especially along the costal margins. Minor attacks of chest pain or dyspnœa, often associated with small increases in the pulse and respiration-rate and temperature, are very common. In some instances anorexia and vague feelings of 'being off colour' have been observed for some hours prior to the development of clinical symptoms. When the leg veins are involved pain is frequently complained of for some hours prior to the onset of swelling of the limb. This pain and the tenderness, which can be elicited on palpation, is felt most along the line of the great vessels. Such evidence of vasospasm as diminished pulsation of the dorsalis pedis artery is commonly found. It is reported

that lumbar ganglion anæsthetization abolishes the vascular spasm and relieves the symptoms (Ochsner).

GROUPING OF SURGICAL PATIENTS FOR PROPHYLACTIC PURPOSES

It is possible by the combined use of the coagulation graph and plasma-fibrinogen B estimations to subdivide patients who are to undergo surgical or obstetrical procedures into four groups :—

Group 1.—In these patients free fibrinogen B does not occur in the plasma and the coagulation graph is of normal type. Intravascular thrombosis does not develop in these cases (*Fig.* 393).

Group 2.—Free fibrinogen B may be found in the plasma, either persistently or intermittently, but the coagulation graph is of normal type. Providing that no previous thrombosis has occurred and is remaining as an intravascular foreign body, and that venous stasis is prevented, thrombosis does not develop in these cases. (*Fig.* 394.)

Group 3.—Free fibrinogen B occurs in the plasma and the coagulation times remain persistently low in the order of 3 to 4 minutes. Intravascular thrombosis appears to be inevitable in these cases, either in the legs or at the lung bases. (*Fig.* 395.)

Group 4.—No free fibrinogen B is found in the plasma but the coagulation graph is consistently low. This combination of the two factors has not occurred in any of the patients studied as a primary phenomenon, but has been seen on several occasions after an intravascular thrombosis has occurred. In each instance it is significant that the thrombosis recurred at the initial site and can be

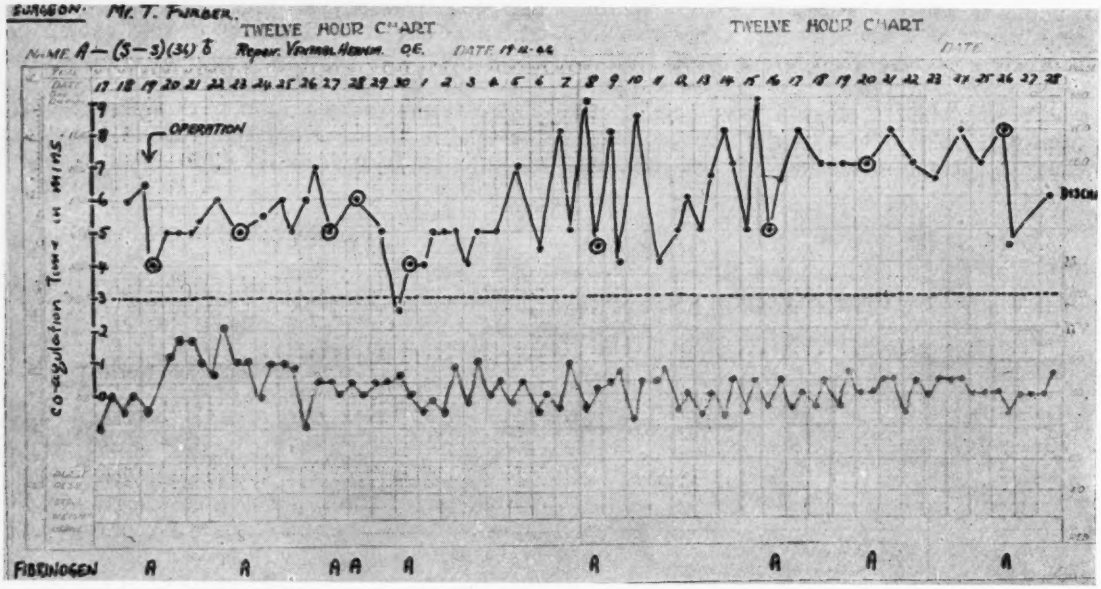


FIG. 393.—The coagulation graph is of normal type and no fibrinogen B occurred in the plasma. Circles round coagulation times indicate plasma was taken for analysis for fibrinogen B at that time.

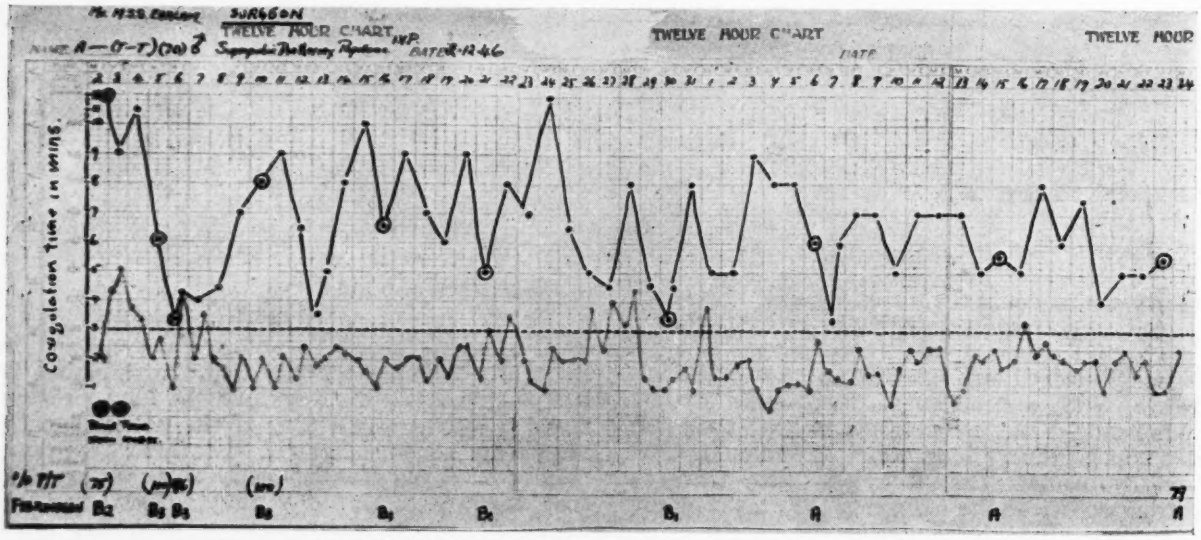


FIG. 394.—The coagulation graph is of normal type, and although fibrinogen B occurred in the plasma no thrombosis developed.

interpreted as a local exacerbation due to the presence of an intravascular foreign body in association with venous stasis. In *Fig.* 396 it can be seen that on the ninth post-operative day a recurrence of the right pulmonary thrombosis occurred when the coagulation times remained persistently low throughout the day, although the plasma was clear of fibrinogen B.

THERAPY OF INTRAVASCULAR THROMBOSIS

The method advocated for the use of the anticoagulant drugs heparin or dicoumarol is both prophylactic and therapeutic. All post-operative patients have a daily, or, if indicated by the presence of pyrexia, twice daily, coagulation time performed.

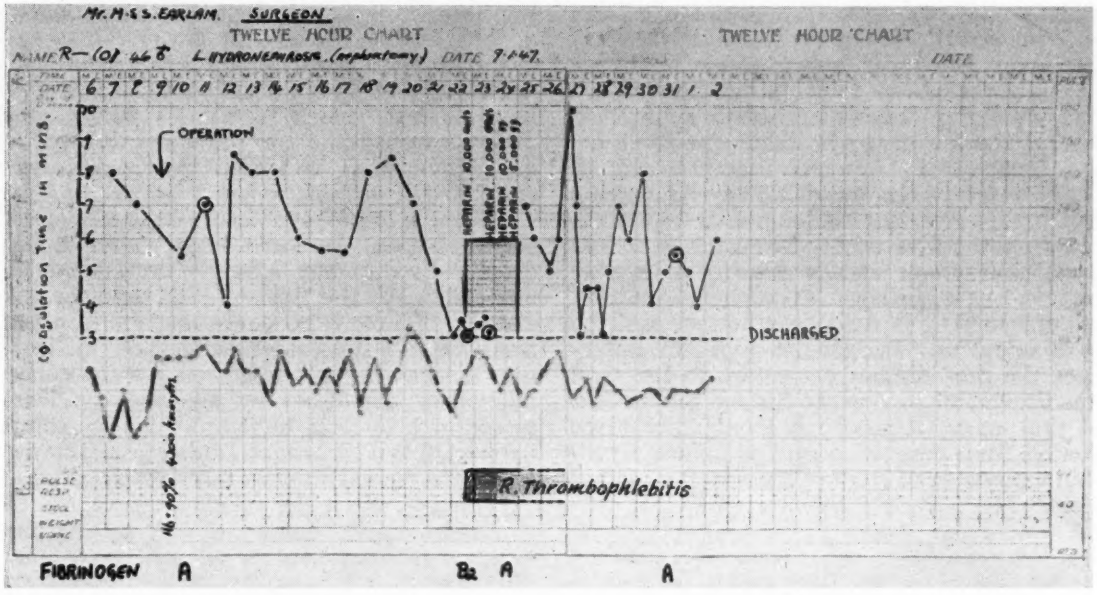


FIG. 395.—The coagulation graph shows a definite fixation at a low level together with the appearance of fibrinogen B in the plasma. Heparin should have been used on these indications without waiting for the development of thrombosis. The presence of a low-grade pyrexia such as is commonly present in these cases is apparent. Heparin does not clear the plasma of fibrinogen B, but by inhibiting the formation and action of thrombin prevents intravascular thrombosis. In some cases such as is here illustrated the development of a thrombosis appears to use up the fibrinogen B and so clear the plasma. This is not always so.

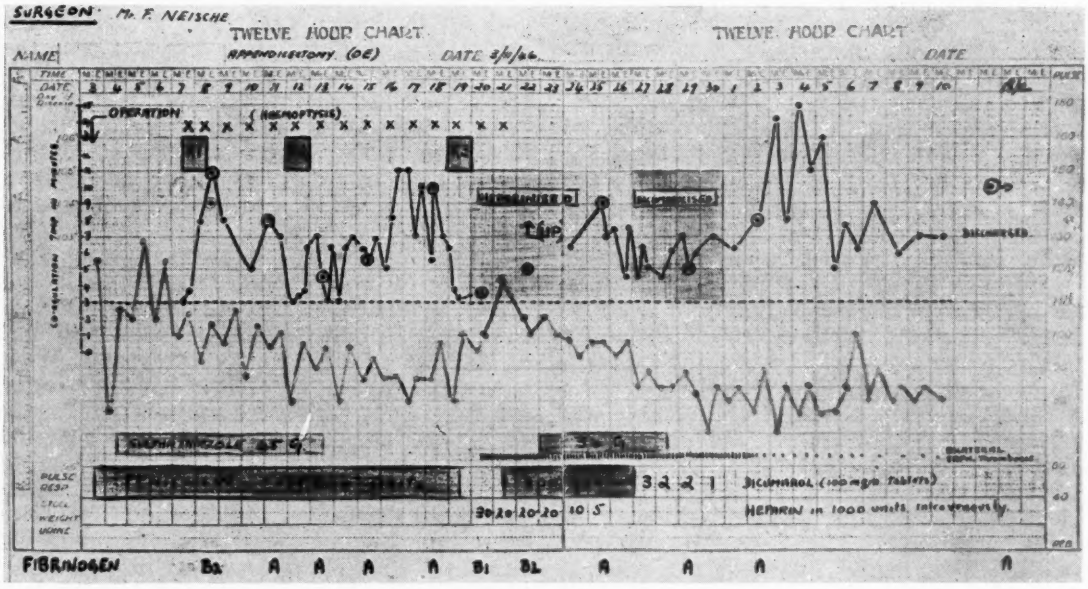


FIG. 396.—Thrombosis occurred in the right lung when the coagulation times were low and fibrinogen B was present in the plasma on the fourth post-operative day. Again, on the ninth post-operative day, a local exacerbation occurred when the times again fell, although the plasma contained no fibrinogen B. This is not uncommon and appears to be due to further clotting occurring on the previous thrombosis, which acts as an intravascular foreign body. A fall in the coagulation time is a warning that further local extension of the thrombus may occur. This patient should have had anticoagulant therapy when the fall in the coagulation time was apparent.

This is recorded as a graph. When there is a depression of the coagulation time to under 4 minutes and this persists for three consecutive hourly readings, 5000 Toronto units of heparin are given intravenously. This dose is repeated if the coagulation graph persists at a low level. When a patient is given heparin the coagulation times are estimated at four-hourly intervals, which is the period of time for which the effect of heparin is apparent. When the first injection of heparin is given, a sample of blood is taken to detect the presence of free plasma-fibrinogen B. If none is found it is unlikely that thrombosis will occur, but should it be present heparin is repeated at four-hourly intervals as required until the coagulation graph returns to normal and the fibrinogen B disappears from the plasma. Dicoumarol may be used instead of heparin in cases where the fibrinogen B persists in the plasma. It is not common that heparin is required after the first twenty-four-hour period as the coagulation graph usually returns to normal at this stage, but if fibrinogen B persists dicoumarol is continued until it is no longer present and the patient is ambulant. It does not appear necessary to reduce the prothrombin percentage to less than 50 with dicoumarol to prevent further thrombosis. Should the patient require bed immobilization or be suffering from congestive cardiac failure a prothrombin percentage of 40 provides a greater margin of safety. Most cases, however, require only 500 mg. before the plasma clears of fibrinogen B. In a few instances larger doses have been required over longer periods and it is this type of case especially that requires careful control by repeated prothrombin estimations.

When a definite pulmonary thrombosis has occurred 10,000 Toronto units of heparin are administered immediately by intravenous injection and the coagulation times are carried out four-hourly. Further heparin is given whenever these times fall below 10 minutes until the pulse and temperature return to normal and the patient's symptoms have disappeared. The persistence of local physical signs is not taken as an indication for continuing with heparin unless the coagulation times are lowered or fibrinogen B persists in the plasma. During the acute stage of the illness the heparin may either be given intermittently by repeated intravenous injections or, more conveniently, a slow saline infusion may be set up and the heparin given by injection through the rubber tubing when indicated by a fall in the coagulation time to below 10 minutes. This latter method has the advantage of being able to be performed by the nursing staff. In most cases dicoumarol is combined with the heparin from the commencement of therapy. An initial dose of 200 mg. by mouth is given with the first injection of heparin and thereafter 200 mg. a day until the prothrombin index (by the method of Quick (1942) and expressed as the 'prothrombin index') falls below 50. This is usually achieved within a dose of 500 mg. The response of patients to dicoumarol varies, and for this reason second daily prothrombin estimations are required to prevent too great a depression of the prothrombin activity which may lead to a hæmorrhagic state. When the plasma contains no free fibrinogen B dicoumarol can be suspended, but the coagulation times should still be performed as further clotting may occur upon the pre-existing clot, which acts as an intravascular foreign body. This, however, only happens if the coagulation times remain low, and can be prevented by an occasional injection of heparin until the patient is fully ambulant and the factor of venous stasis is no longer operative. If fibrinogen B persists in the plasma, even though the coagulation graph is normal, it is advisable to continue with dicoumarol until the patient is out of bed and moving about freely. The presence of venous stasis in this group is of grave significance as further clotting can readily occur. Search should be made in these cases for a focus of infection which may be responsible for the continued production of fibrinogen B and if found this should be eradicated if possible.

When a thrombosis occurs in the leg, treatment should be on the same lines as for pulmonary thrombosis and the affected leg should not be immobilized as this furthers local venous stasis with clotting. There is no doubt that immobilization of the limb to some extent protects the patient from the detachment of fragments, with consequent pulmonary embolism, by allowing the local clot to continue to form until the veins are completely obstructed and there is no further blood-flow. This leaves the patient in most cases with a permanently swollen leg, often painful and subject to chronic ulceration. Thus therapy of this nature, although to some extent protective against the mortality of the disease, adds to the subsequent disability. Free movement of the leg, whilst theoretically rendering the patient more prone to embolism, in practice does not appear to produce this effect in any major degree. In our experience small emboli have become detached and lodged in the lung, but when the patient was receiving adequate anticoagulants no major pulmonary thrombosis developed and no fatal case occurred. It is felt that the explanation of this lies in the fact that the long clots found in the pulmonary vessels of fatal cases are not formed in their entirety in the peripheral vessels, but are formed by spontaneous clotting in the pulmonary vessels upon a small thrombus which may have formed either primarily in the pulmonary vessel or arrived there as an embolus. This factor of superadded clotting can be prevented by the adequate use of the anticoagulant drugs, the detection of a thrombotic state by the coagulation graph, by the estimation of the presence of plasma-fibrinogen B, and by making the patient ambulant as soon as possible to prevent venous stasis. As soon as the patient gets out of bed the affected limb is firmly bound with crêpe bandage as far as the knee to prevent static swelling. This is continued for as long as any tendency to œdema at the ankle is present. The end-result in patients so treated has been most satisfactory in that in no instance did the other limb become affected and in almost all cases the involved limb returned to normal size. Few cases required to remain in hospital beyond the anticipated period following their surgical procedure, no major pulmonary thromboses occurred, and there were no fatalities when the principles of treatment were carefully followed. The number of cases of

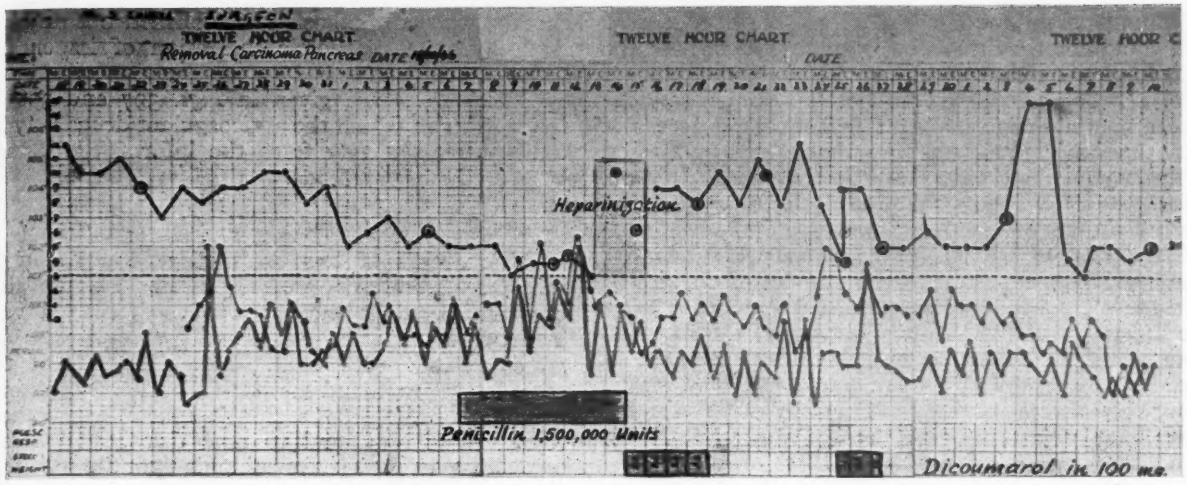


FIG. 397.—This patient had a pancreatico-duodenectomy performed for carcinoma of the pancreas under open ether anæsthesia. The persistent post-operative pyrexia is apparent and the gradual fall of the coagulation times is well seen. When this graph showed the presence of a thrombotic state the pulse and temperature were rising and the pulse was of the *Treppenpuls* type. At the same time the plasma, which had contained no free fibrinogen B after operation, showed this to be present in considerable amount. Heparin and dicoumarol were administered and there was a prompt reduction in the pulse and temperature and a restoration of the coagulation graph to a normal type. It is felt that this is a classical example of the thrombotic state with all its manifestations and that anti-coagulant therapy was responsible for preventing an intra-vascular thrombosis

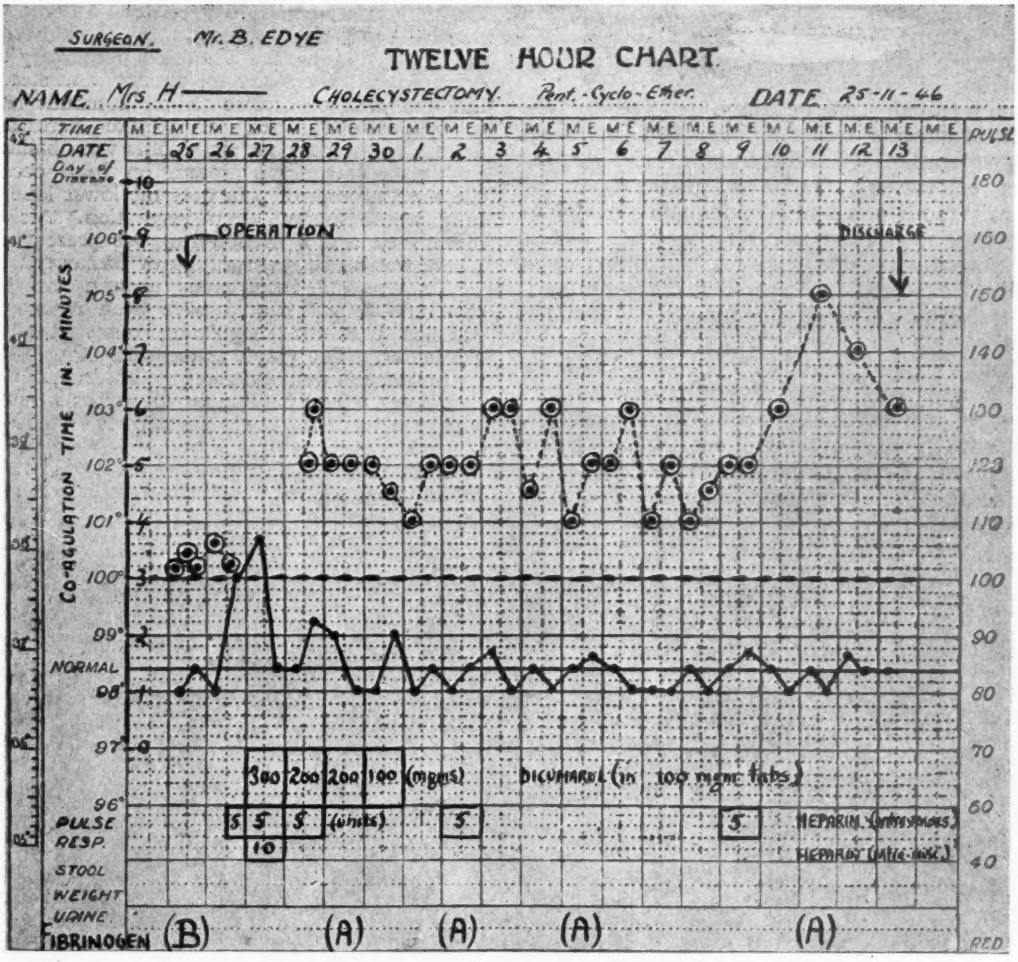


FIG. 398.—This patient had a cholecystectomy performed under pentothal-cyclopropane-ether anæsthesia. Following previous operation four years before, a right femoral thrombosis and left pulmonary thrombosis had occurred. After the cholecystectomy the coagulation times remained persistently low and fibrinogen B was present in the plasma. Anticoagulant therapy was given and no thrombosis occurred. Following operation the patient was very ill and venous stasis was a marked factor.

leg thrombosis treated was 48 and the number of pulmonary thromboses 41. Two deaths occurred in the pulmonary thrombosis group and in both the principles of treatment as indicated were not adhered to. In one case owing to shortage of supply, anti-coagulation therapy was of inadequate degree and in the other recurrent thrombosis occurred when fibrinogen B had remained persistently in the plasma for several weeks. Two days prior to death a temperature of 100° F. was present. No anti-coagulants were given. Two factors were operative in this case, first, the persistence of fibrinogen B in the plasma in a patient who had previously had a pulmonary thrombosis, and, secondly, the fact that he remained in hospital sitting about instead of actively maintaining his circulation rate by carrying out his normal activity. The use of dicoumarol until the plasma became clear of fibrinogen B was indicated.

A few patients are resistant to dicoumarol and considerable dosage does not appreciably lower the prothrombin activity. In such cases heparin must be used, and should fibrinogen B persist in the plasma venous stasis must be overcome by getting the patient up where possible or freely moving in bed when this cannot be done.

THE PROPHYLAXIS OF POST-OPERATIVE THROMBOSIS

Although much can be done to prevent the onset of thrombosis either of the legs or lungs following operation by adherence to the general principles of surgery, such as gentle operative technique, smooth anæsthesia, adequate pre-operative preparation, and the control of post-operative dehydration and infection, the complication cannot be wholly eradicated. There is no doubt that venous stasis is a major contributory factor in the onset of the disease and every effort should be made to prevent this. Patients who develop a fever post-operatively, particularly of the low-grade intermittent type, are especially prone to thrombosis. The use of the post-operative coagulation graph and estimation of the plasma-fibrinogen B would appear to add a valuable weapon to the surgeon's armamentarium, not only from the aspect of therapy when thrombosis is established but prophylactically as a diagnostic indication of impending thrombosis.

Illustrations are given in *Figs.* 397 and 398 of the manner in which the anticoagulant drugs may be used prophylactically from the information gained by use of these methods.

ILLUSTRATIVE CASES

The details of two cases of generalized intravascular thrombosis are presented. In the first case anticoagulant therapy was used, but in very inadequate amounts, and in the second case no anticoagulants were used. The behaviour of the coagulation graph and the plasma-fibrinogen findings in states of thrombosis is well illustrated in these cases. It is important to note that both patients were diagnosed as 'pneumonia' until the true condition was realized. As can be seen from the autopsy findings, the pulmonary condition was a thrombosis in each instance.

Case 1 (*Fig.* 399).—J. P. a male, aged 76, had a suprapubic prostatectomy performed under intravenous pentothal anæsthesia on Jan. 6, 1947. On the twentieth post-operative day a left pulmonary thrombosis developed. On the twenty-eighth day bilateral thrombosis of the femoral veins was apparent. On the thirty-fifth post-operative day a further acute left pulmonary thrombosis occurred, and thereafter the patient went steadily downhill and died of cardiac failure a month later. Prior to operation a history of definite increasing cardiac failure for the previous six months was obtained.

The pulmonary symptom on both occasions was the sudden onset of pain over the lower lobe of the left luug which limited deep inspiration. Air entry was diminished and a friction rub was present posteriorly. There was no cough, sputum, or hæmoptysis.

TREATMENT.—Intravenous heparin was given with each attack, and should have been repeated on each occasion that the coagulation times remained under 4 minutes. The graph at the time of the onset of the leg thrombosis well illustrates the lowering of the coagulation times. Had heparin or dicoumarol been persisted with the second lung thrombosis would not have occurred.

RADIOGRAPHIC FINDINGS.—Serial films show the development of a wedge-shaped infarct at the left

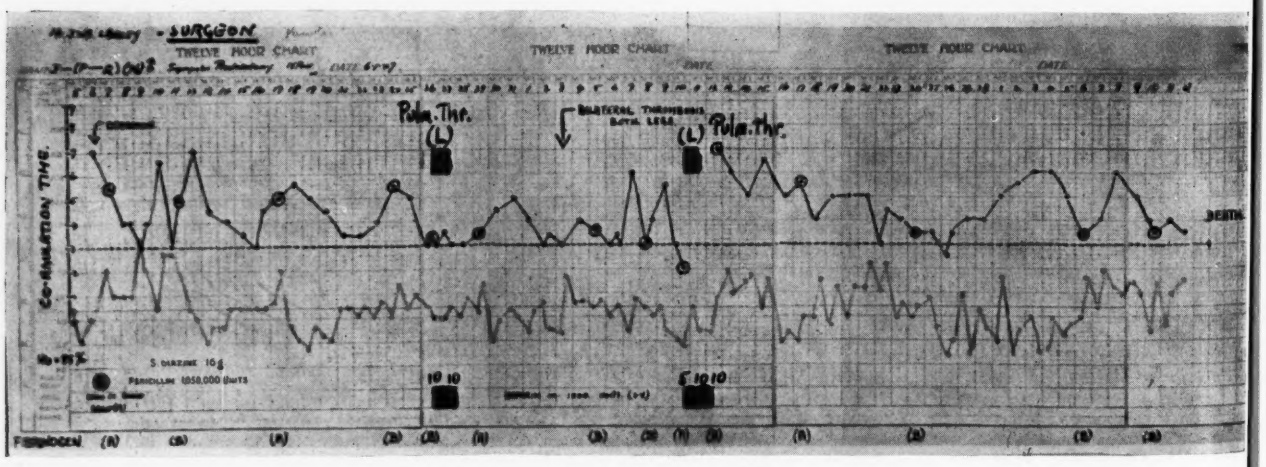
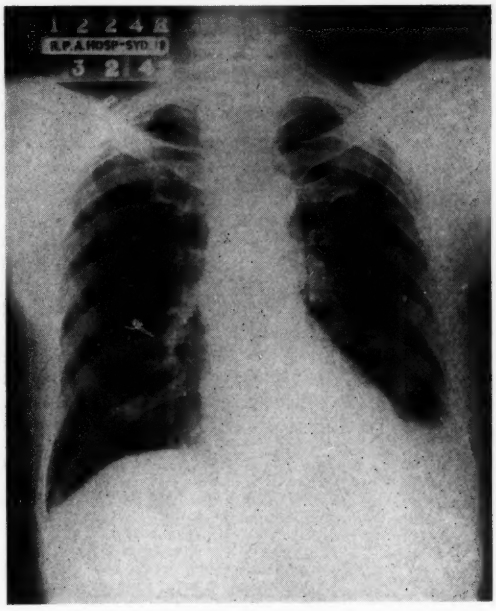


FIG. 399.—This patient had a suprapubic prostatectomy and developed a left pulmonary thrombosis on the twentieth day, and again on the fortieth day.

base in both the anteroposterior and lateral views (*Fig.* 400). This increased steadily in size as the disease progressed and dilatation of the heart became apparent. Towards the end the spread of the condition to the right base was clearly shown. The radiographic findings



A

B

FIG. 400 (Feb. 3, 1947).—In the anteroposterior view (A) the infarction is visible, and in the lateral view (B) the classical dome-shaped basal consolidation is apparent. In the original films the interlobar septa are clearly visible and do not suggest any element of collapse.

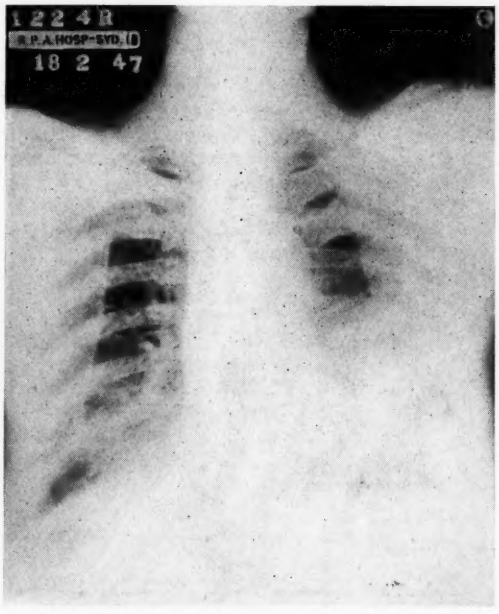


FIG. 401 (Feb. 18, 1947).—This film shows the development of a pleural effusion of the left side, a considerable widening of the base of the heart, and an extension of the thrombosis to the right base. The resemblance to a pneumonic condition is striking.

(*Fig.* 401) suggested a pneumonic consolidation, but this was proved to be an incorrect interpretation.

THE COAGULATION GRAPH.—With the onset of the first pulmonary thrombosis the coagulation graph became fixed in the order of 3 minutes. This was apparent again with the onset of thrombosis in the legs and with the second pulmonary thrombosis.

FIBRINOGEN B.—The plasma was clear of fibrinogen B the day after operation, but thereafter, except on

FIG. 402.—The anterior surface of the left lung viewed from the diaphragmatic aspect. Large formed thrombus can be seen filling the pulmonary vessels.

FIG. 403.—Massive formed clot in both femoral veins.

three occasions, persistently showed considerable amounts of fibrinogen B.

AUTOPSY FINDINGS.—At autopsy old thrombus was demonstrable throughout the pulmonary arteries on both sides (*Figs.* 402, 404), particularly so on the left, and both femoral veins contained thrombus in gross amounts (*Fig.* 403).

Comment.—This case conforms in all respects with the conception of the disease, being a general

FIG. 404.—Formed thrombus is present in the pulmonary artery at the right base. The artery has been opened longitudinally. It was this thrombus that gave rise to the radiographic appearance of 'pneumonia', seen in *Fig.* 401.

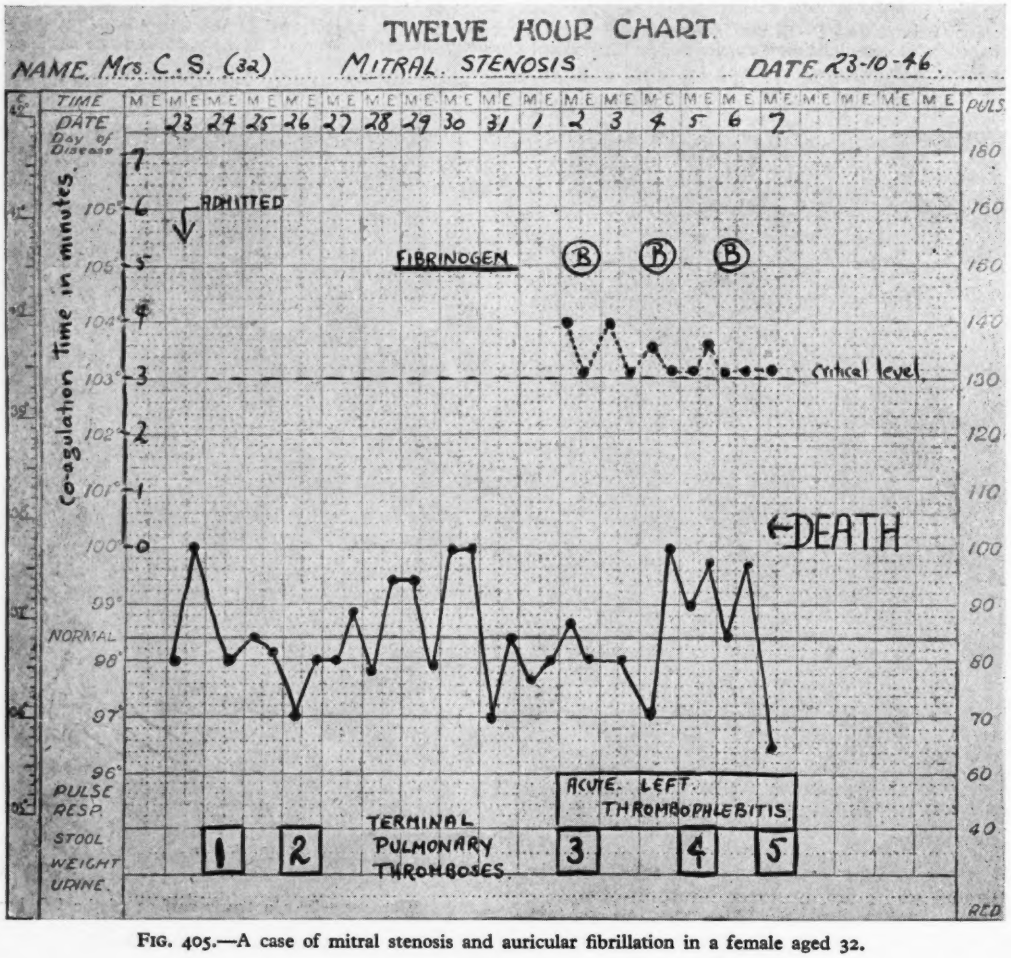


FIG. 405.—A case of mitral stenosis and auricular fibrillation in a female aged 32.

disturbance of the blood-coagulation mechanism, and it appears from the autopsy findings that the thrombosis in the lungs was of primary nature rather than embolic, and little would have been gained by ligation of the peripheral veins. In retrospect, it is apparent that anticoagulant therapy should have been persisted with in a more vigorous fashion in spite of the poor general condition of the senile patient. Death was due to cardiac failure, which doubtless was aggravated by the generalized thrombosis.

It is of interest to note that after each pulmonary thrombosis fibrinogen B disappeared from the plasma but soon reappeared again. This is a common finding, as apparently the fibrinogen B is used in forming the intravascular clot. Sometimes it may disappear completely and at other times diminish in amount. This factor is of considerable importance in the prognosis of recurrent thromboses. If no further fibrinogen B is produced, the likelihood of recurrence is greatly lessened, although with the persistence of venous stasis and the lowering of the coagulation times clotting may occur locally on the basis of the existing clot acting as an intravascular foreign body. In these circumstances no further thrombosis at a different site was observed in the cases studied. When such coagulation times are found it is necessary to persist with anticoagulant therapy, even though the plasma is free of fibrinogen B, until the patient is fully ambulant.

Case 2 (*Fig.* 405).—C. S., a female, aged 32, was suffering from mitral stenosis and auricular fibrillation and was admitted to hospital on Oct. 23, 1946.

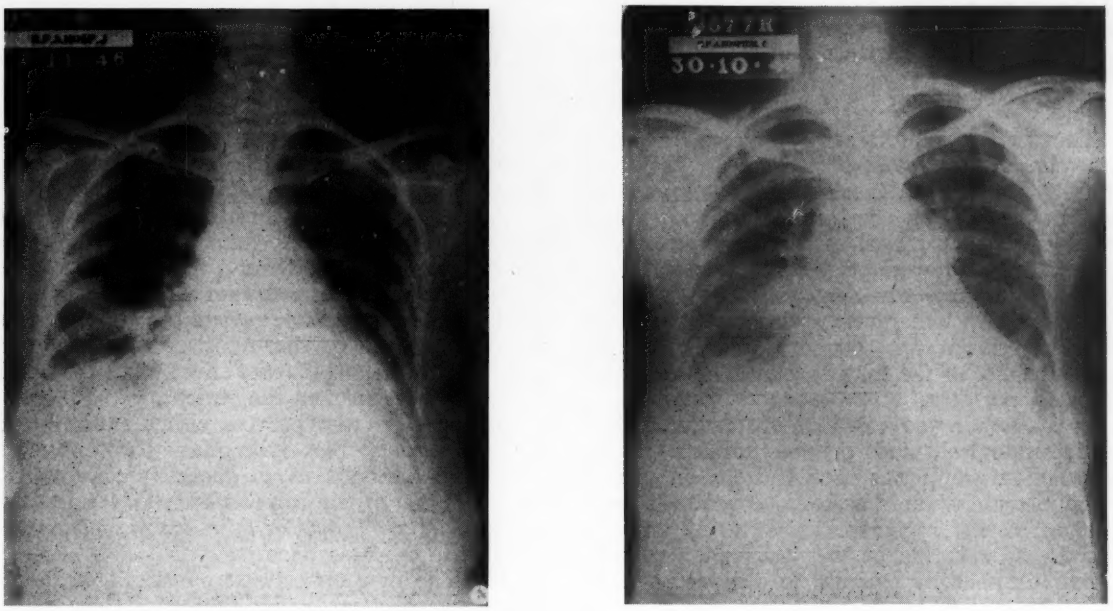
An unresolved right basal pneumonia was diagnosed. There was some œdema of both legs. Five weeks prior to admission, whilst working in the garden, she had experienced a sudden pain in her right chest behind the nipple, which was worse on inspiration. There had been hæmoptysis for several days.

COAGULATION GRAPH.—The coagulation times remained persistently between 3 and 4 minutes. (This is a most important finding.)

FIBRINOGEN B.—The plasma contained fibrinogen B in gross amounts consistently.

RADIOGRAPHIC FINDINGS.—The heart shadow was typical of that seen in mitral stenosis, and on Nov. 4 a patchy consolidation was present at the right base (*Fig.* 406, A). On Oct. 30 an extension of this process from the hilar region in relation to the right pulmonary artery had developed (*Fig.* 406, B).

PROGRESS.—Whilst in hospital, five further minor pulmonary embolisms or thromboses occurred in a fortnight prior to the patient's death. An acute thrombophlebitis was present in the left leg.



A B

FIG. 406.—A, The mitral configuration of the heart is apparent and the patchy basal consolidation on the right side similar to that of pneumonia can be seen. B, A hilar extension has occurred, and this is doubtless due to extension of thrombus into another branch of the pulmonary artery.

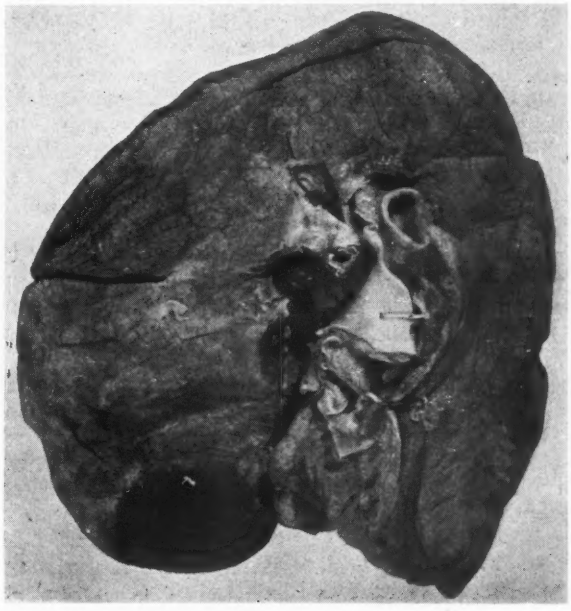


FIG. 407.—The formed thrombus is seen passing into both the descending and ascending branch of the pulmonary artery. A large infarct can be seen at the base and smaller ones at the periphery of the lung. There was no pneumonic consolidation present.

AUTOPSY FINDINGS.—Old formed clot was found in both pulmonary arteries and multiple infarcts of varying ages were present in the lungs (*Fig.* 407). A few small recent thromboses, almost certainly embolic, were present. The femoral veins contained a small amount of clot. The heart valves did not appear to be the focus of origin of the emboli. Anticoagulation therapy was not carried out with this patient.

The supposed 'cardiac œdema' of the legs was of thrombotic origin and the 'pneumonia' also a manifestation of the essential pathological condition from which this patient suffered—generalized intravascular thrombosis.

CONCLUSIONS

1. The prethrombotic state appears to be a definite clinical entity and is capable of being detected by means of the regular post-operative coagulation graph. In one series of 280 patients undergoing major surgical procedures on whom the coagulation times were performed, in 12 instances a prethrombotic state was demonstrated. No anticoagulant therapy was given and in each case an intravascular thrombosis occurred either in the leg veins or those of the lung bases. The incidence was thus 4·3 per cent.

2. In a further 300 cases of obstetrical, gynæcological, urological, and general surgical nature the coagulation graph was used and the anticoagulants administered when indicated. A prethrombotic state occurred in 8 patients and no thrombosis developed. The incidence was thus 2·8 per cent. The great number of patients in this series were young adults and in better condition than those in the former group.

3. There were 48 cases of leg thromboses and 41 of pulmonary thromboses treated with the anticoagulants. Two deaths occurred in the pulmonary thrombosis group. Both were recurrent cases and in both thrombosis of the leg was also present.

4. One case of generalized intravascular thrombosis is reported which was not treated with anticoagulants to demonstrate the correlation of the ante-mortem and post-mortem findings.

5. The relationship of fibrinogen B to intravascular thrombosis is described.

6. Infection and venous stasis were found to be precipitating factors in intravascular thrombosis when free fibrinogen B was found to occur in the plasma and the coagulation times remained at a low level.

7. Methods for the management of intravascular thrombosis, both prophylactic and therapeutic, based upon the use of the coagulation graph and plasma-fibrinogen-B estimations are described.

8. The opinion was formed that the prophylactic interruption of the leg veins was an unnecessary procedure. When a definite thrombosis of the leg is present, vein interruption is more logical but cannot be expected to prevent the development of primary pulmonary thrombosis. Nor has it been satisfactorily shown that its effect upon the involved leg is without harm to the patient.

9. It is far from proven, either clinically or by autopsy studies, that pulmonary thrombosis is as universally embolic as is generally accepted. On the other hand, the impression was formed that a great number of cases of pulmonary thrombosis are primary in the lung itself.

10. The new conception advanced of the basic pathology of intravascular thrombosis suggests that predisposition to the condition may be detected and averted by use of the anticoagulant drugs and measures to prevent venous stasis and infection, and that these methods are also the choice in the management of established cases.

PART II

(BY RAYMOND N. LYONS)

A STUDY of the normal blood-coagulation mechanism indicated that the transformation of fibrinogen to fibrin occurs in two stages and that an intermediate, fibrinogen B, is formed before fibrin (Lyons, 1945). This hypothesis was recently supported by the work of Jeener (1947).

Until this work on thrombosis was commenced, it was not realized that in certain abnormal states fibrinogen B could be present in the blood over a long period without any apparent coagulation process occurring. A consequent survey of surgical and medical patients indicated that in some disorders fibrinogen B was almost invariably present (Jackson and Lyons).

Although fibrinogen B is a contributing factor in post-operative thrombosis, the fact that it is present in plasma does not necessarily mean that thrombosis will occur, but if, in addition, there is a persistently low coagulation time, this is a strong indication that intravascular thrombosis is about to occur. The significance of the two factors occurring together will be discussed below.

In human subjects it was noticed that fibrinogen B occurred in the plasma when there was a site of pyogenic infection. In order to demonstrate the role of tissue necrosis 22 rabbits whose plasma contained normal fibrinogen A were injected intramuscularly in the buttock with 2 ml. of sterile oil of turpentine to produce sterile abscesses. Twenty-four hours after this injection every rabbit had a high concentration of fibrinogen B in the plasma (*Table VI*). Sterile pus was withdrawn from these intramuscular abscesses and injected intravenously into another series of 12 normal rabbits (0·5 ml./rabbit). All these rabbits showed maximal amounts of fibrinogen B in the plasma in 24 hours (*Table VII*). Blood samples were taken by cardiac puncture and oxalated immediately (2·0 ml. blood + 0·2 ml. 1·1 per cent sodium oxalate). Plasma was then obtained by centrifuging the blood.

The results outlined in *Tables VI* and *VII* indicate that fibrinogen B is formed where there is a site of pyogenic tissue necrosis and that an active principle causing its formation may be present in the sterile pus.

With the appearance of fibrinogen B in the blood, both human and rabbit, there is a coincident increase in the blood-sedimentation rate, almost maximal

sedimentation frequently occurring in 20 to 30 minutes. Fibrinogen B is not, however, the only factor which increases the blood-sedimentation rate, as this phenomenon occurs when fibrinogen B is not present in the plasma, but it appears to be an important one. Microscopically, blood containing fibrinogen B and normal blood to which fibrinogen B has been added, show interesting abnormalities. The erythrocytes exhibit increased rouleaux formation and the platelets an increased 'stickiness' and tendency to agglutinate.

This increased 'stickiness' of the erythrocytes and platelets is almost certainly the cause of the increased blood-sedimentation rate, and persists for 1 to 2 weeks after the fibrinogen B has disappeared from the plasma. Several workers have postulated that the platelets become coated by a layer of fibrin, which makes them agglutinate and disintegrate readily on foreign surfaces (Apitz, 1939; Leggenhager, 1936). Apitz (1939) is of the opinion that profibrin is the substance which coats the platelets. However, fibrinogen B and profibrin are not identical, although both appear to play an important part in thrombosis. Over one thousand plasma tests on 91 patients who developed post-operative thrombosis showed that subsequent to the appearance of fibrinogen B in the plasma a further intermediate between fibrinogen and fibrin appeared which could be gelled by addition of alcohol (10–15 per cent concentration) and appeared to be identical with the profibrin described by Apitz (1937).

This substance also has a marked effect on the blood-sedimentation rate and is much more labile than fibrinogen B.

Fibrinogen B differs from profibrin in that it is not flocculated by decreasing or increasing the sodium chloride concentration (up to 50 per cent saturation), is readily soluble, and is not gelled by addition of alcohol, even in excess.

The increased fragility of platelets in the presence of fibrinogen B was demonstrated *in vitro* by the following experiment (*see Table VIII*): For the paraffined tube-test, blood was withdrawn by cardiac puncture, using a paraffined needle and syringe, and introduced into 13 × 100 ml. tubes which had been coated with paraffin wax. Both needles and syringe were coated inside with hard paraffin first and then washed out with paraffin oil. It was interesting to note that the clot first formed on the sedimented corpuscles, binding them together into a solid lump before the supernatant plasma clotted.

Human plasma containing fibrinogen B has recently been used in the Department of Surgery, University of Sydney, as a means of correcting the coagulation defect in hæmophilia. This is of interest because it has often been suggested that platelets of hæmophilic blood are abnormally stable (Howell and Cekada, 1926; Tocantins, 1935; Hirschboeck and Quick, 1941). Details of these experiments will be the subject of a further publication.

It appears that the venous endothelium obtains its oxygen from the blood in the lumen of the vein

Table VI.—The Effect of Sterile Abscesses on the Blood-fibrinogen of 22 Normal Rabbits.

Plasma clotted by naphthoquinone	0	0	22	22	22	20	16	5	5	1	0
Days	1	2	3	4	5	6	7	8	9	10	11

↑ Intramuscular injection of 2 ml. sterile oil of turpentine.

Table VII.—The Effect of Injection of Sterile Pus suspended in an Equal Volume of Sterile Physiological Saline into 12 Normal Rabbits.*

Plasma clotted by naphthoquinone	0	0	12	12	12	8	3	0	0
Days	1	2	3	4	5	6	7	8	9

↑ Intravenous injection of 0·5 ml. sterile pus.

* All rabbits developed a high concentration of fibrinogen B within twenty-four hours. There is a possibility that oil of turpentine or its degradation products might be a causative factor, as no doubt these were present to some degree in the emulsified pus injected into the rabbits. Further work from this aspect is being carried out with pus to which merthiolate has been added.

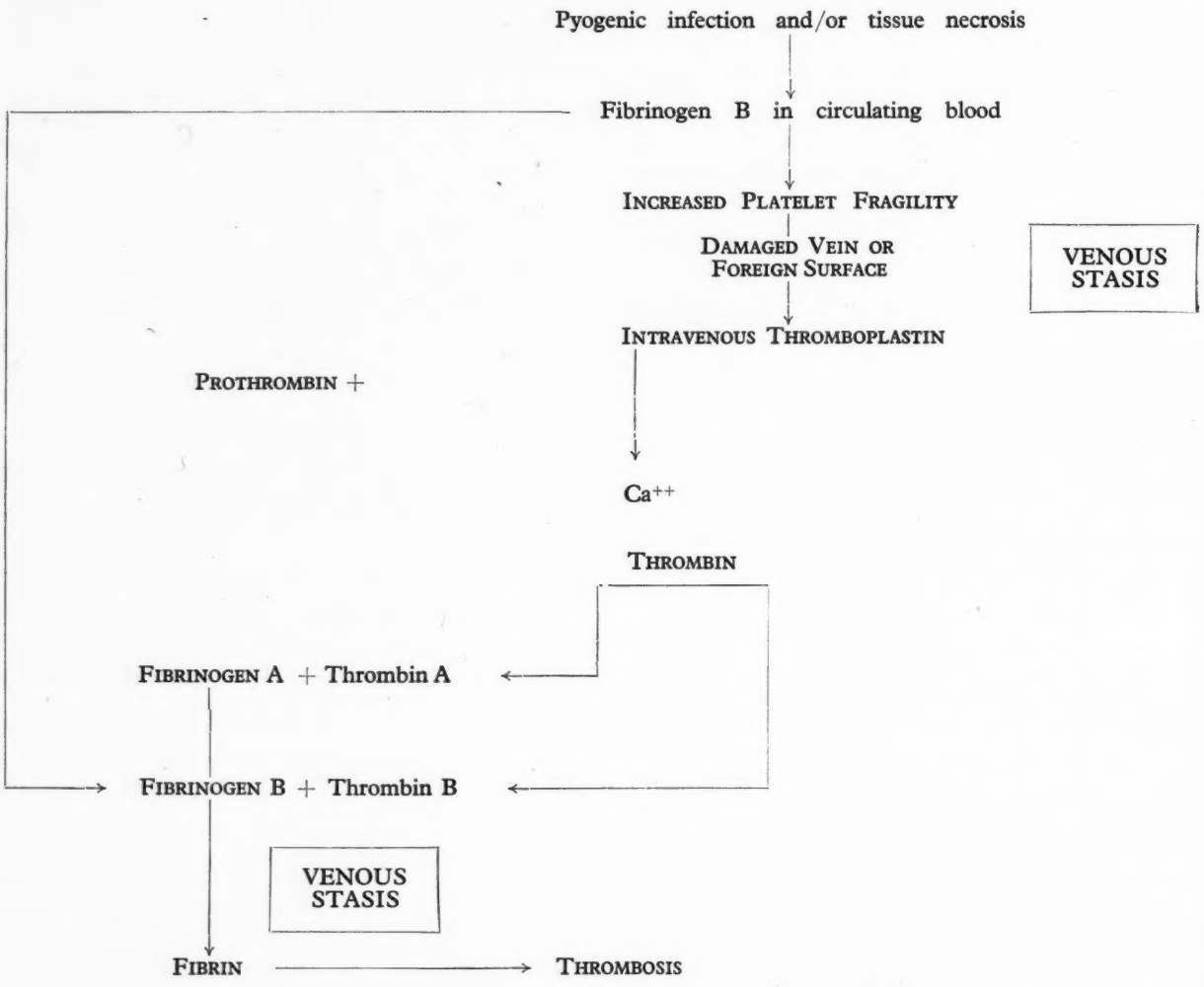
Table VIII.—Comparison of Platelet Fragility in Normal Rabbits and Rabbits with Fibrinogen B in Their Plasma as a Result of Sterile Abscesses

Rabbit No.		Coagulation Time (Lee–White)	Coagulation Time (Paraffined Tube)
Normal	1	125 seconds	Over 8 hours
	2	110 ,,	,, 8 ,,
	3	130 ,,	,, 8 ,,
Fibrinogen B in plasma	4	120 seconds	17 minutes
	5	125 ,,	35 ,,
	6	135 ,,	28 ,,

and that when this oxygen supply is diminished as in venous stasis the endothelium undergoes degenerative changes and supplies a ready site for platelet disintegration. Consequently with stasis and in increased fragility of platelets we have the conditions necessary for the liberation of intravenous thromboplastin.

It is also interesting to note that with indisputable clinical signs of thrombosis the fibrinogen B disappears almost completely from the plasma in most cases, and in those cases where it remains it is present in diminished amounts. Frequently, however, it may subsequently reappear.

The following scheme is put forward as a possible way in which intravascular thrombosis could occur :—



Observations on human subjects and animals fully support this hypothesis. Nolf (1922) showed that intravenous injections of a thromboplastic substance were capable of completely defibrinating the blood of animals. He noted that there was first a marked lowering of the coagulation time, followed later by a greatly increased coagulation time and finally complete inhibition of clotting due to defibrination of the blood. During this investigation it was often noticed that human subjects with fibrinogen B in their blood and a low coagulation time (2 to 3 minutes) frequently had an active thrombin in their circulating blood. Blood samples, withdrawn and oxalated within 5 seconds, still clotted within a few minutes in spite of all precautions which were taken.

As a further check of the results obtained in the investigation of post-operative thrombosis and the hypothesis suggested as the blood-coagulation mechanism in thrombosis, the effect of intravenous injection of thrombin into sheep was studied with this end in view.

Six sheep were used in this experiment and their coagulation time by the Lee-White method was estimated twice daily for two days before the injections were commenced. The coagulation time was found to be relatively constant provided the following criteria were observed :—

1. The blood was taken by venepuncture from the jugular vein at a constant rate, 3 seconds per millimetre, using a No. 20 Yale B-D needle. If there was any difficulty in introducing the needle into the vein a clean syringe and needle were used. If there was any frothing of the blood the coagulation time was repeated, as frothing reduces greatly the coagulation time.

2. The needle was removed from the syringe and 1 ml. of blood was carefully introduced into each of three tubes 15 × 100 mm. kept at a temperature of 37° C. The blood was maintained at a temperature of 37° C. and the tubes were tilted every 15 seconds. If there was a discrepancy of more than 30 seconds between any of the three tubes the test was repeated.

The normal coagulation times of the six sheep are set out in *Table IX*. The effect on the coagulation time of sheep D, E, and F following intravenous injection of the thrombin prepared from the plasma of sheep A, B, and C is set out in *Table X*.

Table IX.—Coagulation Times done by the Lee-White Method twice daily
(Expressed in Seconds)

Sheep	Day 1		Day 2	
	10 *a.m.*	4 *p.m.*	10 *a.m.*	4 *p.m.*
A	195	195	210	210
B	195	210	210	210
C	180	195	195	195
D	225	240	225	225
E	210	210	210	210
F	195	180	195	195

Table X.

Sheep D. Weight 105 lb.
(Coagulation time range for previous two days, 225 to 240 seconds)

Time		*Coagulation Time (Lee-White) Sec.*	
12.00 noon		240	
12.05 p.m.	Injection	20	ml. thrombin from sheep C
12.10 „		270	
12.20 „		180	
12.50 „		180	
1.20 „		180	
1.50 „		180	
2.50 „		180	
4.50 „		210	

Sheep E. Weight 78 lb.
(Coagulation time range for previous two days, 210 seconds)

Time		*Coagulation Time (Lee-White) Sec.*	
11·30 a.m. (Sept. 20, 1947)		210	
11.40 „	Intravenous injection	20	ml. thrombin from
11.45 „		240	[sheep B
12.00 noon		120	
12.15 p.m.		150	
12.30 „		120	
12.45 „		135	
3.45 „		165	
8.00 a.m. (Sept. 21, 1947)		195	
11.30 „ (Sept. 22, 1947)		210	

Sheep F. Weight 108 lb.
(Coagulation time range for previous two days, 180 to 195 seconds)

Time		*Coagulation Time (Lee-White) Sec.*	
12.15 p.m. (Sept. 24, 1947)		195	
12.30 „	Intravenous injection	30	ml. thrombin from
12.35 „		240	[sheep A
12.45 „		165	
1.00 „		150	
2.30 „		165	
3.30 „		210	
12.00 noon (Sept. 25, 1947)		195	

The thrombin solutions were injected at the rate of 1 ml. in 5 seconds.

It was found that blood-samples taken and oxalated immediately, even up to 20 hours after injection of thrombin, gave small clots in spite of the removal of Ca ions.

Three hundred millilitres of blood were then taken from each of three sheep (A, B, and C) into 33 ml. of 1·1 per cent sodium oxalate.

The individual plasmas were obtained by centrifuging and prothrombin was prepared by diluting the plasma ten times and acidifying to *p*H 5·3. The resultant precipitate was dissolved in 30 ml. physiological saline at *p*H 7·3 and 1·5 ml. of M/50 $CaCl_2$ was added. The fibrin clot which formed was stirred out and each preparation of thrombin was Seitz-filtered separately for intravenous injection.

Potency Tests.—Thrombin from sheep A clotted an equal volume of sheep plasma in 24 seconds.

Thrombin from sheep B clotted an equal volume of sheep plasma in 13 seconds.

Thrombin from sheep C clotted an equal volume of sheep plasma in 15 seconds.

Quick (1941) has recently shown that the thrombin-inactivating power of blood is slight whilst fibrinogen remains in the blood. However, it is not established yet whether intravenous thrombin can stimulate the production of an antithrombin which retards the prothrombin ⟶ thrombin conversion. Where small amounts of intravenous thrombin are present this factor could appreciably affect the coagulation time.

Since no obvious intravascular thrombosis occurs in active animals following intravenous injections of small amounts of thrombin, Quick (1942) postulates that the fibrin formed is filtered out by the capillary bed and disposed of by fibrinolysis.

These animals which maintain a good circulation cannot be compared with immobilized human subjects in whom venous stasis becomes a definite factor.

Types of Thrombosis.—Three different types of thrombosis have been encountered at Royal Prince Alfred Hospital, Sydney:—

Type 1.—A primary thrombosis which follows a prolonged operation. There is extensive tissue trauma and formation of thrombin, which gives rise to intravascular thrombosis within twenty-four hours of operation.

This type of post-operative thrombosis is relatively uncommon and may reasonably be expected after an extremely long operative procedure. In this type fibrinogen B need play no part in causing the thrombosis, but a Type 2 thrombosis may easily follow.

Type 2.—This is the most common form of thrombosis, and the one mainly dealt with in this paper.

It appears to be due to an increased fragility of platelets resulting from the presence of fibrinogen B in the blood. This type can occur from two days to several weeks post-operatively. A persistently low coagulation time and the presence of fibrinogen B in the blood are an indication that thrombosis is imminent.

Type 3.—A thrombo-embolic condition caused by a dislodgement of a clot and a subsequent mechanical infarction, following a Type 1 or Type 2 thrombosis.

Test for Fibrinogen B in Plasma.—4·5 ml. of blood are taken by venepuncture into a paraffined

syringe (for clinical purposes a sterile dry syringe was often used and was found equally satisfactory), and well mixed with 0·5 ml. 1·1 per cent sodium oxalate. The blood is then centrifuged and the supernatant plasma pipetted off; 1 ml. of plasma is then added to five drops of reagent in a 13 × 100-mm. tube. If mixing is not complete the tube is carefully shaken and is then allowed to stand for 10 minutes, when it is examined for clot formation.

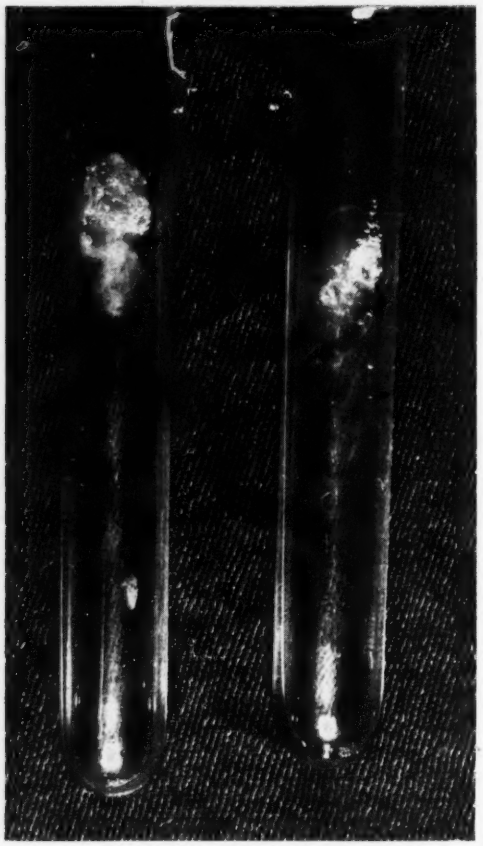


FIG. 408.—The gel formation is clearly seen in these two tubes, which have been photographed from above.

The resultant gel formation when fibrinogen B is present in the plasma is illustrated in *Fig.* 408.

It must be emphasized that the important fact in the interpretation of the test is the presence of fibrinogen B more than the amount, and from the clinical aspect the test is essentially qualitative rather than quantitative.

The reagent used in this test is prepared by dissolving 2 g. β-naphthol in 100 ml. of 50 per cent alcohol and then exposing this solution to oxygen, when it turns brown. It is not essential to aerate the reagent, but when this is done it appears to increase the rate of gel formation. Since this solution contains 50 per cent alcohol, both fibrinogen B and profibrin give positive results. However, profibrin only appears when the fibrinogen B concentration has become very high.

If it is necessary to determine fibrinogen B alone, then a 5 per cent aqueous solution of hydroquinone-quinhydrone can be used, and the plasma is examined for clot formation after 30 minutes. However, as the presence of both fibrinogen B and profibrin is of significance clinically from the viewpoint of thrombosis, it is desirable to use the test which demonstrates the two substances—namely, the aerated alcoholic β-naphthol.

SUMMARY

Post-operative thrombosis may be divided into three classes:—

1. Immediate post-operative thrombosis (i.e., within twenty-four hours) presumably due to the formation of a considerable amount of intravenous thrombin formed during an extremely long operation by excessive tissue trauma.

2. Delayed post-operative thrombosis indirectly caused by the presence of fibrinogen B associated with venous stasis. These factors cause platelet disintegration and intravenous thrombin is formed. Stasis again plays a part in preventing the normal metabolism of the fibrin which is formed.

3. The mechanical detachment of embolic fragments.

Contributing factors in Type 2 thrombosis appear to be: pyogenic infection and/or tissue

A B C D

F/B+ F/B++ F/B+++

FIG. 409.—Shows the results of the fibrinogen-B test with four types of plasma.

A, Normal fibrinogen A, which shows no gel formation at all with the reagent even though excess be added.
B, Low concentration of fibrinogen B, appears more definite in the photograph because of the lighting effect. Designated as fibrinogen B +. Weak gel formation.
C, Medium concentration of fibrinogen B. Designated as fibrinogen B + +. Moderate gel formation.
D, High concentration of fibrinogen B. Designated as fibrinogen B + + +. Strong gel formation.

necrosis ⟶ fibrinogen B in circulating blood + platelets ⟶ increased platelet fragility + venous stasis ⟶ intravenous thromboplastin ⟶ intravenous thrombin (low coagulation time) ⟶ fibrin + stasis ⟶ thrombosis.

Both fibrinogen B and profibrin are factors which increase the blood-sedimentation rate, and tests for their clinical determination are described.

The direction and co-operation of Professor H. R. Dew, of the Department of Surgery, the University of Sydney, has been invaluable in the completion of this study and we gratefully acknowledge his assistance.

Professor B. T. Mayes, of the Department of Obstetrics, the University of Sydney, has earned our special thanks for his ready assistance and support on many occasions.

We wish to express acknowledgement and thanks to the members of the Medical, Surgical, Obstetrical, Pathological, and Radiological staffs of the Royal Prince Alfred Hospital for their ready co-operation and assistance.

A great deal of the work was carried out in the Department of Urology, and we are grateful for the guidance and assistance given us by Mr. J. W. S. Laidley, Mr. M. S. S. Earlam, Mr. A. Walker Smith, and Mr. A. L. Carrodus, the Surgeons of this department.

The nursing staff of the Royal Prince Alfred Hospital have largely made this study possible by performing the routine coagulation times, and we wish to express our appreciation of their help. Sister K. Mulligan and Sister J. Smythe have been particularly helpful in this regard.

Mr. S. Woodward Smith, of the Department of Medical Artistry, the University of Sydney, has carried out all the photographic work in the course of this study and we gratefully acknowledge his assistance.

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THE SURGERY OF DUODENAL ULCER

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THE case for subtotal gastrectomy in the treatment of chronic duodenal ulceration as illustrated in this series has already been presented in a general way elsewhere (Wells, 1946). The purpose of the present paper is to describe in detail the stages by which these conclusions were reached. It is based on a continuous series of 363 personal cases, all operated upon in the ten-year period 1935–44 by one of the writers; the follow-up and analysis has been largely the work of the other.

Much of the more recent literature in this country and in America favours subtotal gastrectomy for the relief of duodenal ulcer and with this we are in entire agreement (Lewisohn, 1945; Allen and Welsh, 1942; Sanders, 1945; and others). It appears from our results that the operation, if well planned and executed, is amongst the most satisfactory—if it is not indeed *the* most satisfactory—of the routine operations in general surgery. In order, however, to be sure of consistently good results it is necessary to seek for underlying principles and to formulate a system of rules designed to respect these principles. In attempting this task on the evidence of our own material, it seems that certain very definite conclusions can fairly be drawn from a comparison of the different results in the different types of operation performed.

SELECTION OF CASES

Before going on to the consideration of the results of operation in the various groups, the selection of cases must be discussed. For this purpose we have excluded from consideration hæmorrhage and perforation as emergencies, but have included them and pyloric stenosis as factors in the general argument.

1. Pyloric Stenosis.—This may be caused by organic fibrosis but is most often precipitated by œdema or spasm. The majority will yield to non-operative measures and pyloric stenosis is only a relative indication, not an absolute one as is often supposed. It is, however, important, in this connexion, to remember that differentiation between simple ulcer of the duodenum and carcinoma of the pyloric antrum causing obstruction is very difficult by X-ray. On total, serious delay in the emptying of the stomach is a good indication for operation and the operation should aim at relief of the cause as well as the complication. A gastro-enterostomy is no better for being done in the presence of pyloric stenosis, and, in fact, the very cases in which obstruction occurs are those in which the ulceration is most active. Anastomotic gastrojejunal ulcer is therefore a likely sequel if a short circuit alone is done. Admittedly, a safe gastrectomy may call for a two-stage operation. This is discussed again later.

2. After Perforation.—Should a patient who has perforated once be submitted to gastrectomy? This is a question which should not be asked or answered in this form. A single perforation may occur in the course of an acute illness and the criteria on which the decision to operate should be based are the criteria discussed under (4) and (5) below. After two or more perforations, a gastrectomy should almost certainly be advised.

3. Hæmorrhage.—Certain cases of hæmorrhage can only be saved by operation, but this is not pertinent to the present discussion. What is revelant is that the occurrence of bleeding may be the deciding factor in favour of operation in a case of chronic ulceration previously in doubt. In such cases, the operation may with advantage be undertaken at the time of the bleeding. Similarly, repeated hæmorrhages constitute a good indication for partial gastrectomy.

4. Failure of Non-operative Measures.—The most extreme, conservative view is that surgery has no place even in the cases most resistant to medical treatment unless they become complicated, by which is generally understood the supervention of stenosis, hæmorrhage, or perforation (Colp and others, 1944). This view derives from fear and lack of faith—fear of operative mortality and lack of faith in surgical end-results. We hope to show that under the best conditions the mortality is low (*see also* McKittrick, Moore, and Warren, 1944) and that, if the right operation is done, the results are consistently good. If these points are conceded it would appear right to advise operation in cases in which medical treatment has been given a fair trial and failed.

5. Social Considerations.—A discussion of this subject must take social conditions into account. It will probably be agreed that the patient who can take life easily and who can contrive to live well, has a better chance of carrying on contentedly within a medical régime. The manual worker and the man compelled to travel awkward journeys and work hard, may find it difficult to follow medical advice. The seafarer may be compelled to abandon his profession for fear of perforation or hæmorrhage and because of the difficulty of obtaining regular and suitable meals. All these considerations are points in favour of operation—assuming that the operation offers freedom from the restrictions imposed by a medical régime. This we believe we can show to be the case. Under this heading it seems desirable to point out that we have failed to find any evidence of there being an ulcer-prone type. Within our limited experience we have found duodenal ulcer at all ages and in all classes and types of individual—the only clear preponderance being that of males over females. The Registrar-General's statistics (1942) for deaths from duodenal ulcer show a similarly even distribution over all wage-groups of the community.

It would be profitless to particularize further. If, in all the circumstances, the patient is unable to carry out the advice he is given, or, having carried it out to the best of his ability, he finds himself unable to carry on his allotted life successfully, medical treatment may fairly be said to have failed

and surgery should be advised. Surgery should mean subtotal gastrectomy whenever possible.

6. Refusals.—No patient has been refused operation because of his extremity of illness. In the past, many cases have been deemed fit for only local anæsthesia, but, with curare and pentothal now available, we find no need to employ local any longer, either alone or as an adjuvant. No one has been refused because of old age. Occasionally one is compelled to contemplate operation in the very young because of hæmorrhage or continued crippling dyspepsia; our present view is that if any operation is necessary it should be a gastrectomy, as in the older patients. We have come to this decision with reluctance, because the steps of a gastrectomy can never be retraced. The alternative, however, is a gastro-enterostomy followed by careful supervision and conversion to gastrectomy at a later date in the event of stomal ulceration. This seems the less desirable plan.

PRE-OPERATIVE PREPARATION

X-ray examination, fractional test-meal, blood-picture, and radiography of the chest are usual though not invariable. Oral sepsis has usually, though by no means always, received attention in the course of medical treatment. Blood is not ordinarily cross-matched as transfusion is seldom needed. Vitamin C should certainly be given if the diet has been strict before operation and is probably better given in all cases. Fluids are given, up to the time of the operation, and a Ryle's tube is passed through the nose before leaving the ward. Morphine gr. $\frac{1}{6}$ and atropine gr. $\frac{1}{100}$ are given an hour (or more—not less) before operation.

ANÆSTHESIA

Every type of anæsthesia has been given a trial—spinal, splanchnic, local, ether, gas–oxygen–ether, cyclopropane, and—most recently—curare with pentothal. The last named is far superior to the others. Full surgical anæsthesia with complete control is combined with rapid recovery and a minimum of after-effects. A remarkable feature is the maintenance of blood-pressure during long operations. Chest complications are always a danger in upper abdominal operations but are undoubtedly reduced to vanishing point by this anæsthetic combination. If trouble is to be consistently avoided, care must be taken in the choice of anæsthetist and selection of anæsthetic. Spinal anæsthesia, as applied to the upper abdomen, seems to us to be quite undesirable on account of lowering of blood-pressure, nausea, retching, and general distress and anxiety. In addition, post-spinal headaches may seriously mar an otherwise good convalescence. Most grateful thanks are due to the anæsthetists who have given so much to make this work a success.

CHOICE OF OPERATION

Prior to 1935 various operations were carried out by us in the attempt to relieve this condition. After gastro-enterostomy had been found unreliable, gastrectomies were undertaken, with the most variable results—some were excellent and others most disappointing. Subsequent events have convinced us that this uncertainty was due to the fact that the operation was not standardized. A variable amount was taken away and the distal division may have been made either distal or proximal to the pyloric sphincter. Even the operation notes did not always make this point clear, since its importance was not at that time understood.

Between 1935 and 1944 in our cases four groups can be recognized:—

1. The group in which the pylorus was left behind. This group served to emphasize the importance, in the production of hydrochloric acid, of the pyloric antrum even when excluded from the food-stream.

1a. The sub-group in which the pyloric antrum (however small the fragment) was removed at a further operation.

2. The Billroth I type of operation.

3. The inadequate partial gastrectomies.

4. Subtotal gastrectomy.

These groups occur in this order and a study of the results will make it clear why we conclude that subtotal gastrectomy is the operation of choice.

For consistently good results certain steps are essential. The whole pyloric end up to and including the pyloric sphincter must be removed. The stomach must be divided proximally above the level of the left gastric artery, i.e., the removal must be subtotal. Of these two points we are sure. Thirdly, we believe the divided stomach should be anastomosed to the jejunum rather than to the duodenum and that the stoma should be made so that the efferent loop comes away from the most dependent point, namely, the greater curve. Finally, we think the lesser curve end of the stoma should be 'valved' to prevent dumping into the afferent loop. We prefer the antecolic arrangement to the retrocolic. (*See also* Colp, 1944.)

It would appear that the removal of the pyloric antrum is necessary to exclude gastrin (Edkins' hypothesis, 1906), the subtotal removal of the proximal part of the stomach necessary to reduce the acid-producing area, and the anastomosis with the jejunum necessary to introduce alkaline juice, derived mainly from the pancreas.

The only technical difficulty arises in separating and closing the duodenum. This may prove really tedious and may at times give rise to real cause for alarm. The closure must be quite satisfying if one is to avoid calamities. Inversion of the stump should be free and easy and non-absorbable sutures should be used in whole or in part (McNealy, 1942). In cases in which the common duct is at risk we have made use of the fundus of the gall-bladder in a manner which is described later. Generally, the difficult case should be assessed in time, and a two-stage procedure adopted (Boice, 1942). The difficult ones may be very difficult indeed.

Conversion to subtotal gastrectomy is the procedure of choice in all cases in which recurrent ulceration has followed some lesser procedure. Attempts to compromise in order to avoid so big an undertaking are foredoomed to failure. Here, there is no satisfactory two-stage operation or other means of avoiding the major undertaking. On the other hand, the operation is usually well tolerated and the results are excellent. The same remarks apply to cases with gastrojejunocolic fistula. These should

be prepared with sulphasuxidine and a radical operation should then be carried through boldly.

CASES REVIEWED

(1935–1944)

There were 363 patients suffering from duodenal ulcer who were submitted to operation. Several patients had two or more operations. Five patients failed to survive their operations—a mortality of less than 2 per cent. Most of the operations were carried out in the war years in any one of half a dozen hospitals and a dozen nursing-homes and the supervision of after-treatment was often difficult. We have inevitably lost sight of many of the patients —their homes have been obliterated—they themselves have been translated to other countries and even other worlds—many were seafaring and others foreigners in transit. Despite our best efforts we have been able to follow up only 200 of our cases.

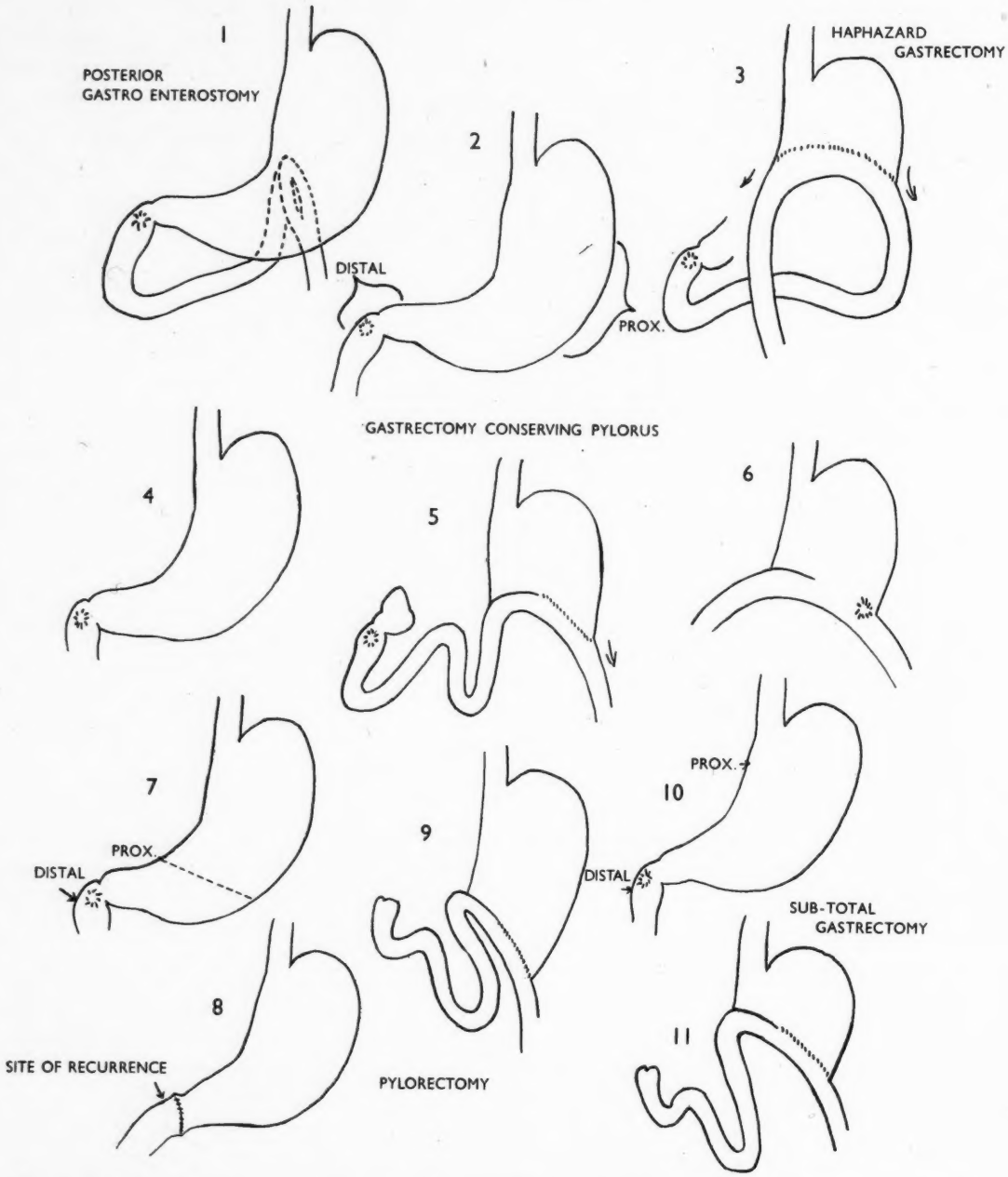

FIG. 410.—1, Posterior gastro-enterostomy. 2, 3, 'Haphazard' gastrectomy. The levels of division are indeterminate and the jejunum may go right to left or left to right. No precaution is taken against dumping. 4–6, Gastrectomy without removal of pylorus. The operation is easy, but recurrent ulceration is common. This is usually relieved by subsequent pylorectomy. 7, 8, Pylorectomy alone, whether completed end-to-end or stomach-to-jejunum (9) is inadequate and recurrence is common. 10, 11, Subtotal gastrectomy includes removal of the pylorus and high division of the stomach. The stoma should be designed to prevent dumping. The remaining stomach should be capable of being covered by the fingers of the right hand.

CAUSES OF DEATH

(*In a Series of* 363 *Patients*)

Five Operative Deaths have been attributed as follows :—

Case 159.—J.S., aged 47. 1939. Duodenal leak.
Case 211.—C. F. R., aged 42. 1940. Duodenal leak.
Case 193.—A. P., aged 64. 1942. Duodenal leak.
Case 181.—J. L., aged 45. 1944. Bronchopneumonia.
Case 60.—W. J., aged 54. 1945. Bronchopneumonia.

Four Delayed Post-operative Deaths (not included in computation of over-all operative mortality); all occurring several weeks after discharge :—

Case 89.—H. W., aged 44. 1944. Homologous serum jaundice.
Case 154.—A. T., aged 37. 1943. Homologous serum jaundice.
Case 149.—E. B., aged 48. 1935–6. Recurrent ulceration 3 months post-operative. Pylorus not removed.
Case 192.—W. M., aged 56. 1935–6. Perforated recurrent ulcer. Pylorus not removed.

POST-OPERATIVE MORBIDITY WITH RECOVERY

This table is very incomplete and indeed no attempt has been made to complete it. Only a fraction of the cases have been picked up in going through the notes, but the most important post-operative conditions are illustrated by these four cases :—

Case 187.—J. C., aged 68. 1943. Leaking duodenal stump. Laparotomy—suction drainage—recovery.
Case 217.—G. S., aged 43. 1941. Acute dilatation of stomach. Ryle's tube—suction drainage—recovery.
Case 51.—T. P., aged 50. 1945. Parotitis. Penicillin—recovery.
Case 218.—E. L., aged 47. 1941. Billroth I. Acute dilatation of stomach.

It is important to emphasize that the low mortality bears no relationship to the anxiety of the post-operative period. Careful watch needs to be kept over these patients if tragedies are to be avoided. The greatest tribute must be paid to the sisters, nurses, and residents who looked after them, often under the most trying circumstances.

FOLLOW-UP OF CASES

Gastrectomy without Removal of Pyloric Antrum (34 cases).—

Results satisfactory (9 cases).
Died of intercurrent disease (3 cases).—Said to be: (1) perforated appendix, (2) pulmonary tuberculosis, (3) cerebral conditon.
Continued ill health ending in death (1 case).—
Case 167.—C. K., aged 41. Operation, 1937. Never picked up after operation and died two years later.

Died of recurrent ulceration (2 cases).—
Case 149.—E. B., aged 48. 1935, gastrectomy, pylorus conserved. Three months later died with massive posterior ulcer. P.M. done.
Case 192.—W. M., aged 56. 1935, gastrectomy with conservation of pylorus. 1936, perforation and subphrenic abscess. Died.

Unsatisfactory, but nothing further done (4 cases).—
Case 200.—G. S., aged 48. 1938, operation. Now says—pain after food and vomiting. Has not been helped by operation.
Case 185.—A. D., aged 22. Operation, 1935. Reports pain after food. Some vomiting. Losing weight.
Case 139.—G. E. P., aged 36. Operation, 1936. Reports "overloaded" stomach, gastric irritation, occasional vomiting.
Case 141.—G. H., aged 38. Operation, 1936. Symptoms recurred 1–2 years. Lost sight of now.

(These four need re-admission with a view to further operation.)

Unsatisfactory and followed by pylorectomy with relief (12 cases).—
Case 101.—W. W., aged 55. 1937, gastrectomy with recurrent symptoms. 1944, pylorectomy. 1946, very well.
Case 177.—T. L., aged 49. 1916, P.G.E. 1936, gastrectomy, pylorus not removed. 1938, further operation, pylorus not removed. 1940, pylorectomy. 1946, very well.
Case 178.—F. H., aged 59. 1937, gastrectomy, pylorus conserved. 1937, enormous stomal ulcer—jejunostomy. 1939, perforation; pylorectomy. 1946, very well.
Case 143.—G. B., aged 44. 1939, gastrectomy, pylorus conserved. 1939, perforation; pylorectomy. 1946, very well.
Case 181.—G. B., aged 45. 1937, gastrectomy, pylorus conserved. 1939, enormous anastomotic ulcer; pylorectomy. 1946, extremely well, full work, full play.
Case 221.—W. W., aged 40. P.G.E. at St. Bartholomew's Hospital, London. 1937, gastrectomy, with conservation of pylorus. 1938, stomal ulcer; pylorectomy. 1946, very well.
Case 172.—W. B., aged 45. 1936, first operation. 1939, pylorectomy, very large ulcer. 1946, very well.
Case 138.—H. R., aged 29. 1937, gastrectomy, conservation of pylorus. 1938, January, gastrectomy at higher level. 1938, July, pylorectomy. 1946, very well.
Case 195.—A. R., aged 42. 1938, gastrectomy with conservation. 1944, pylorectomy. 1946, well.
Case 137.—W. H., aged 38. 1937, gastrectomy, pylorus conserved. 1941, requires pylorectomy. 1942, pylorectomy performed. 1946, very well.
Case 142.—W. C., aged 37. 1936, gastrectomy, pylorus conserved. 1939, pylorectomy, massive ulcer in left hypochondrium not touched. Relief. Recent follow-up not known.
Case 145.—P. C., aged 42. 1937, gastrectomy, pylorus conserved. 1938, anastomotic ulcer. Hb, 37 per cent. 1938, February, jejunostomy. 1938, June, rising acid curve in F.T.M. 1939, big ulcer; pylorectomy. 1946, very well, enthusiastic.

Followed by pylorectomy and re-gastrectomized at a higher level (1 case).—
Case 190.—J. D. (1) P.G.E. (elsewhere) date unknown. (2) P.G.E. undone, low resection, pylorus not removed (elsewhere). (3) Further exploration, nothing done (elsewhere). (4) 1942, profound anæmia, anastomotic ulcer; pylorectomy. (5) 1942, September, unsatisfactory relief from previous operation; re-gastrectomized at higher level. (6) 1946, enthusiastic.

Followed by pylorectomy without complete relief (2 cases).—Should be re-admitted with a view to higher gastrectomy.
Case 133.—W. W., aged 38. 1937, gastrectomy without pylorectomy. 1938, pylorectomy. 1946, reports unsatisfactory progress with pain and vomiting of watery material.

Case 107.—R. R., aged 45. 1938, gastrectomy with conservation of pylorus. 1938, later, anastomotic ulcer; pylorectomy. 1940, incomplete relief; investigated, N.A.D. 1942, slight recurrence of symptoms. 1946, needs to diet but keeps well.

Limited Partial Gastrectomy (29 cases).—Pyloric antrum removed but stomach resected at a lower level than in the subtotal operation. Gastrojejunal anastomosis. The demarcation of this group is not always easy.

Satisfactory (19 cases).—The satisfactory reports tend to be less enthusiastic than those in the subtotal group.

Unsatisfactory (10 cases).—

Case 82.—A.T., aged 46. 1942, penetrating duodenal ulcer with stenosis; limited gastrectomy. 1944, recurrent symptoms. 1946, gastrojejunocolic fistula; anastomosis undone and converted to subtotal.

Case 214.—M. W. (F.), aged 50. 1941, perforation. 1942, pylorectomy, i.e., limited gastrectomy. 1946, epigastric pain; gastroscopy, N.A.D. Improved on unrestricted diet.

Case 69.—A. W., aged 22. 1942, perforation. 1942, limited gastrectomy for recurring severe pain. 1945, continued dyspepsia.

Case 134.—J. Y., aged 35. 1938, limited gastrectomy. 1946, recurrent symptoms for six years, pain and occasional vomiting.

Case 56.—J. L., aged 45. 1942, February, perforated duodenal ulcer. 1942, May, limited gastrectomy. 1942, November, perforated jejunal ulcer. 1946, has had vesical calculus removed; is very well.

Case 118.—N. D., aged 31. 1931, perforated duodenal ulcer. 1941, pylorectomy and end-to-end anastomosis. 1943, limited gastrectomy. 1945, perforated ulcer. 1946, no further symptoms.

Case 129.—J. H., aged 43. 1941, laparotomy (elsewhere)—no ulcer found. 1942, April, limited gastrectomy, rapid return of symptoms. 1942, September, subtotal gastrectomy. 1946, very well.

Case 34.—B. O., aged 52. 1941, limited gastrectomy for hæmatemesis. 1942, subtotal gastrectomy. 1946, V.G.R.

Case 151.—G. W. (F.), aged 33. 1940, P.G.E. 1942, pylorectomy. 1943, subtotal gastrectomy. 1946, V.G.R.

Case 52.—A. E. L., aged 59. 1941, limited partial gastrectomy. 1942, subtotal. 1946, reports V.G.R.

(Five of these patients should probably have a further resection done at a higher level.)

Case 191.—Recorded under Billroth I.

Billroth I Operation (24 cases).—Resection of a variable amount of stomach and end-to-end anastomosis between stomach and duodenum. An unusually high proportion of women in this group.

Satisfactory (15 cases).—6 women and 9 men.

Unsatisfactory (9 cases).—

Case 176.—R. J., aged 27. 1940, ten years' dyspepsia—rising acid curve; Billroth I and vagotomy. 1942, severe pain in R.I.F. 1945–6 continued pain.

Case 5.—C. H., aged 45. 1941, duodenal ulcer with stenosis; Billroth I. Symptoms returned 2½ years post-operation, some vomiting; rigid diet, fair only.

Case 147.—T. S., aged 49. 1939, large, active duodenal ulcer. 1946, Result poor—would welcome further operation.

Case 164.—C. B., aged 33. 1936, active ulcer; Billroth I. 1941, symptom free. 1946, slight return of pain.

Case 191.—T. J., aged 43. 1914, perforation. 1929, P.G.E. 1939, Billroth I. 1941, repair epigastric hernia and vagotomy. 1943, limited partial gastrectomy. 1946, subtotal gastrectomy with relief to date.

Case 216.—Mrs. F., aged 70. 1920, appendix and cholecystectomy. 1941, Billroth I. 1942, subtotal. 1946, V.G.R.

Case 215.—J. P., aged circ. 50. 1939, Billroth I. 1940, advised further operation. 1946, subtotal for active recurrence.

Case 152.—E. J. S., aged 44. 1941, Billroth I. 1943, subtotal for active recurrence. 1946, reports V.G.R.

Case 23.—E. A., aged 35. 1941, Billroth I. 1942, subtotal. 1946, reports V.G.R.

Subtotal Gastrectomy (114 cases).—

End-result very good (112 cases).

Result not satisfactory (2 cases).—

Case 136.—S. L., aged 37. 1925, P.G.E. 1938, P.G.E. undone. Gastrectomy, pylorus not removed. 1939, pylorectomy. 1945, epigastric pain, fullness after food, bilious vomiting. Investigation negative.

Case 61.—M. A. W. (F.), aged 70. 1936, resection mid-third stomach only. 1941, stenosis of stoma. 1943, pylorus removed, gastrectomy at higher level. 1946, reports pain, dizziness, nausea, bilious vomiting, and loss of weight.

SUMMARY OF DEDUCTIONS FROM RESULTS

From the evidence of the experiences quoted we may draw certain definite conclusions:—

1. Pylorectomy is essential in the control of hyperchlorhydria. High resections without pylorectomy fail. Relatively low resection *with* pylorectomy *may* give a good result.

2. The pylorus is presumably responsible for the elaboration of gastrin even when excluded from the food-stream which was previously believed to be the effective stimulus.

3. High resection of the stomach is essential for a high percentage of good results.

4. Hence we deduce that the acid-secreting function of the middle third of the stomach is dominant and that its mucin-producing function is subordinate. Removal of the acid is imperative. Loss of the mucin is unimportant.

5. Gastrojejunal anastomosis appears to give better results than gastroduodenal (type Billroth I) end-to-end anastomosis. This may be a false deduction, since in most of the examples of Billroth I quoted, the resection of the stomach was inadequate. But in the presence of inadequate resection, anastomosis to the duodenum seems more often to lead to trouble than anastomosis to the jejunum.

6. This suggests that neutralization of residual gastric acidity by the alkaline jejunal content is the third important factor.

OPERATIVE TECHNIQUE

The objectives have already been defined—subtotal removal of the stomach with an effective non-dumping gastrojejunal anastomosis. This involves proximal division of the stomach above the point of entry of the left gastric artery and sacrifice of at least two or three of the vasa brevia. The distal division is beyond the pylorus. There must be no compromise on either of these two points. We prefer the antecolic jejunal loop because we think it easier and quicker than the retrocolic and just as satisfactory, whilst the retrocolic manœuvre introduces the risk of some obstruction where the mesocolon embraces the jejunum. It is also, we believe,

important to bring the distal loop away at the greater curve. This ensures the stomach's emptying into the efferent limb. The Hoffmeister or Finsterer type of stoma then gives complete protection from dumping into the afferent limb. Custer and Butt (1946) have analysed and discussed fully the dumping syndrome which has given rise to much comment in the United States, where the characteristic symptoms are well recognized. This phenomenon has not appeared in our patients.

The *great omentum* is sacrificed if its nutrient vessels are ligated left and right. This seems

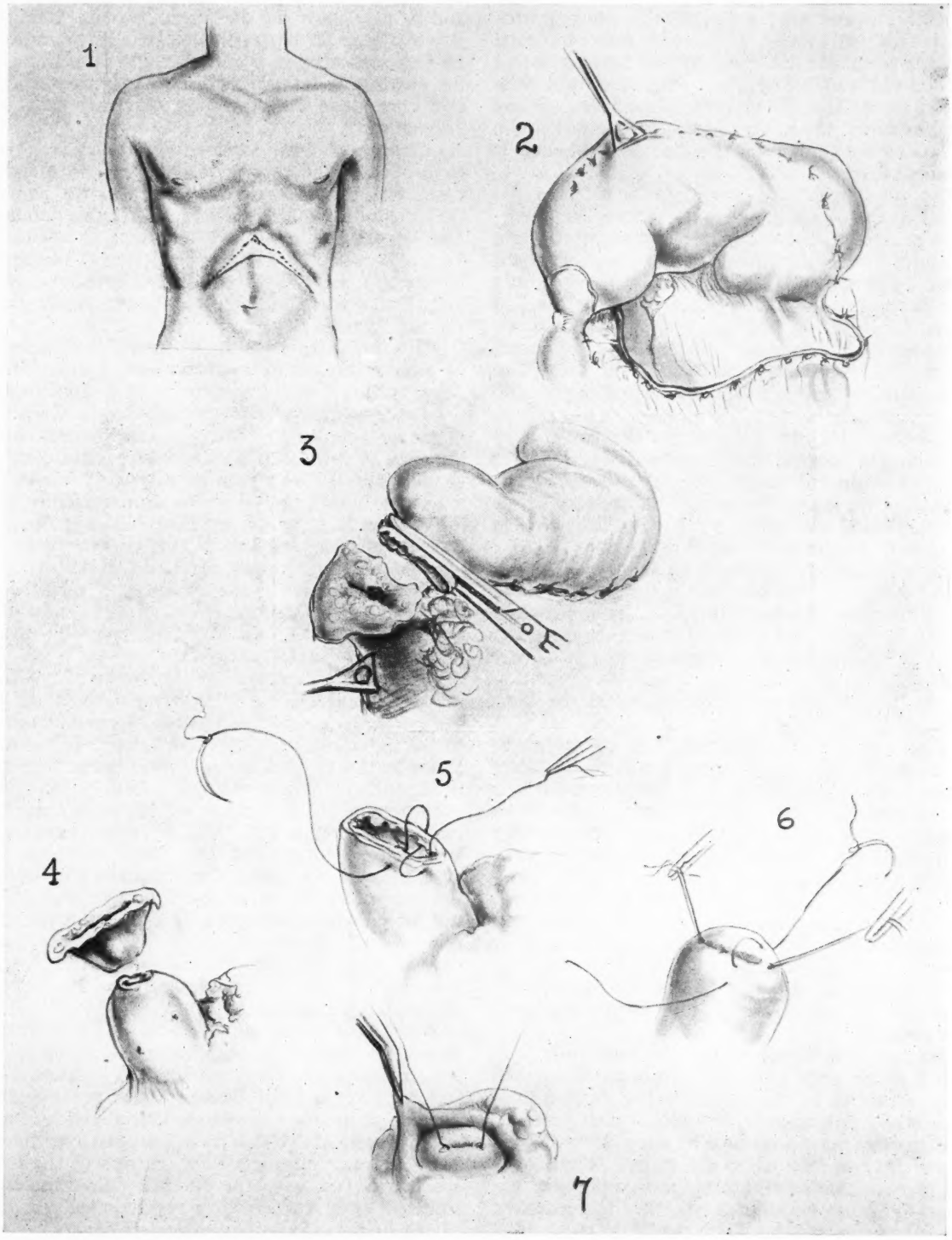

FIG. 411.—1, Continuous line shows curved high transverse incision; broken line shows double Kocher incision which gives better access upwards. 2, Separation of the gastro-epiploic arch, showing how the branches fail to reach the region of the pyloric vein, and how the arch falls away from the duodenum. 3, Pylorus clamped and duodenum divided on the clamp. 4, Duodenum proximal to stenosis removed and discarded. 5–7 Closure of duodenal stump.

undesirable and we have always followed the practice of conserving the blood-supply. This involves the rather tedious tying-off of a large number of small vessels running between the gastro-epiploic arch and the greater curve. These vessels stop short of the pylorus where there is a short, bare area, before the duodenum is reached. As the further dissection extends on to the duodenum itself, it is best to keep very close to the gut, although the right gastro-epiploic falls well away. The vessels may be picked up in one hæmostat and then divided between it and the duodenal wall. The distal ends bleed but little and can be picked up in turn if need be. Filmy adhesions across the lesser sac may cause the middle colic artery to adhere to the stomach, whence it separates easily.

The *duodenum.* An early decision must be reached on the possibility of doing a complete operation in one stage, because once the dissection of the duodenum is begun the ulcer may perforate and it may be impossible to retreat. Difficulty only arises in the case of ulcers penetrating the head of the pancreas, but an apparently easy case with an anterolateral ulcer may be found to be complicated by a second lesion as the work goes on. Cases in which there is a gross inflammatory and hyperæmic mass are certainly better left to a two-stage procedure. Two to three months' rest allows the reaction to settle completely and the duodenum can then be dealt with easily and with safety. An added advantage at this time is that the normal intestinal gradient is re-established and there is relatively little risk of the sutured duodenal stump blowing out.

If a two-stage operation is to be done, the stomach should be divided 2 in. from the pylorus. Anything less is difficult to close comfortably. This is a good point of section in the doubtful case also, since the mobilized pyloroduodenal fragment affords a very useful hold on the duodenum and its separation from the stomach improves the access to the duodenum (Hinton, 1943). Normally, however, if a one-stage operation is intended, the duodenum is cleared on all sides to half-an-inch beyond the ulcer and the pylorus is clamped without encroaching on the duodenum. The latter is cut across with diathermy, close to the clamp, after suitable packing to avoid soiling. The duodenum will not run away much, but can be supported with a Duval tissue-forceps. Tissue proximal to the ulcer is then cut away, if interfering with infolding, and the cut end closed with a Schmieden suture of chromic gut. If the access is at all difficult, the further closure can with advantage be postponed until the gastrectomy proper has been completed. The approach is then much easier.

The risk of a blow-out must be kept constantly in mind as the work proceeds. In order to be safe, it is necessary to be able to infold the divided duodenum easily and securely, and this in turn demands that the preliminary clearance be adequate in length and free from embarrassing deformity. Physiologically, the removal of the ulcer is unimportant, but technically it may be difficult to close the duodenum if the ulcer has not been cut away or cut across. Every scrap of duodenum beyond the ulcer should be regarded as a precious asset. In most cases the duodenum proximal to the ulcer is only a liability, and this is especially true when there is any degree of stenosis, which always interferes with inversion We advise sacrificing everything down to the ulcer and conserving everything possible beyond it.

Inversion of the duodenal stump is secured with two layers of interrupted thread sutures. Fine nylon would possibly be even better. The operator must not rest until he is assured of a safe inversion and, if necessary, the duodenum should be followed down a little farther at this stage. But it must not be forgotten that in these cases the duodenum may be greatly shortened by long-recurring ulceration and fibrosis, and the common duct may be reached very quickly.

Cholecyst-duodenostomy.—Injury to the common duct in the course of dissection in a difficult case, with penetration of the head of the pancreas, may create an anxious situation. If the duodenum can be safely closed and the duct sutured satisfactorily, well and good. The crux of the matter, however, is that the new problem is usually presented before the duodenum has been sufficiently cleared for satisfactory closure.

In this event, the fundus of the gall-bladder may be freed a little and joined end to end with the duodenal stump. No infolding of the duodenum is needed, and this effects an economy of tissue. At the same time, an alternative channel is provided for the flow of bile, and, finally, the procedure may be carried out without fear of ascending cholangitis, since the duodenum is diverted from the food-stream. This procedure, which we have not seen described elsewhere, was adopted in two of our cases with success and without untoward incident.

It has not been our practice to mobilize the duodenum from the outside at an early stage of the operation in order to identify the common duct, as is advised by some surgeons.

The Bancroft (1932) procedure we have found unsafe. It involves gastric transection, 2 in. from the pylorus, as already described, followed by removal of the pyloric mucosa by coring it out from within, as far as the pylorus itself. The fibromuscular and peritoneal cuff which remains is then closed. This, however, is not so simple as it sounds, since the remaining tissues are poorly supported and the sutures tend to cut out.

Similarly, we cannot lend support to closure of the stump by suture of the free duodenal edge to the margin of an unseparated ulcer adherent to the duodenum. Inversion and peritonization are imperative if tragedies are to be avoided. (*See also* Perelman, 1937; Partipile, 1938; Horsley and Bigger, 1940; Slive, 1943.)

Gastric Section and Stoma.—The stomach is turned up and to the left in the usual way and the left gastric vessel is divided between ligatures. The lesser curve is then cleared more completely by division of its nutrient vessels over a length of about 1½ in. at and above this level. By passing the right hand up under the left ribs, the tips of the fingers are carried up over the fundus. The amount of stomach to be conserved is approximately as much as can be covered by the extended fingers.

A loop of 8 in. to 10 in. is left free as the jejunum is draped into position and held with a clamp—proximal end to the lesser curve. As the anastomosis

is made, two-thirds to three-quarters of the cut end of the stomach is thrown into the stoma, the remaining fraction being closed, at the lesser curve or proximal end, to form a valve. The valve should not be so large as to reduce the stoma below three fingers approximately.

Secondary Removal of the Duodenum.—The second part of the two-stage operation is best approached through a Kocher's gall-bladder incision. It may be somewhat difficult to display the pyloric stump owing to omental and other adhesions, but once it has been identified it should be brought up

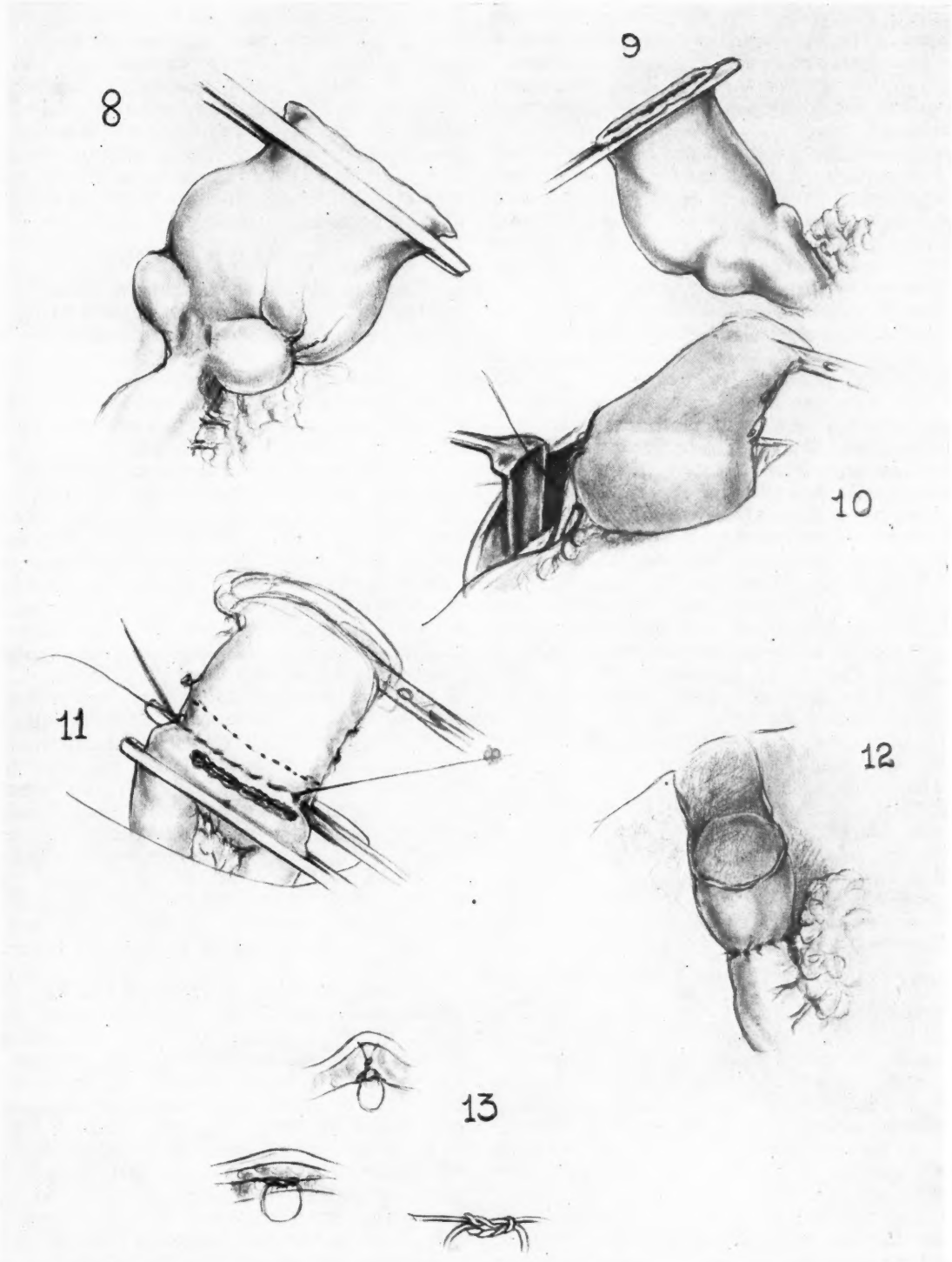

FIG. 412.—8, 9, Grossly deformed duodenum. The stomach has been divided across to allow better access in clearing the structures from the head of the pancreas. 10, Tying the left gastric artery. 11, The anastomosis. Sero-muscular suture completed and jejunum opened. Line of section of stomach indicated by dotted line. 12, Fundus of gall-bladder eased from its bed and anastomosed end-to-end with duodenum after damage to common bile-duct and gross shortening of the duodenum from long-standing ulceration. 13, The double surgeon's knot does not stick up and irritate the overlying skin.

in the tissue forceps and further dissection should be carried out as close as possible to its wall. All signs of inflammatory reaction disappear between the two operations and the procedure may now be quite easy. However, in cases in which there has been vigorous ulceration over a long period the duodenum may be very much shortened and may be bound to the head of the pancreas by very tense scar tissue. The ulcer, in these cases, is invariably on the pancreatic aspect of the duodenum, because it is only in this situation that such an active process can continue for so long without perforation into the peritoneal cavity.

We have already referred to the fact that in these cases the gastrojejunal stoma has become established and normal intestinal gradient re-established. As a consequence it seems likely that the risk of a duodenal blow-out is minimal. It may very well be that a relatively insecure suture line would hold. On this point, however, we have no experimental or operative experience to offer and it has been our practice to carry out the same meticulous closure and inversion as has been recommended in the one-stage operation. Although easier, this may yet not be easy and the greater part of an hour may be consumed in carrying out the operation. Adherent ulcers may perforate in the course of dissection and the common bile-duct is not immune from injury.

Closure.—At the end of the operation the gastric suture lines run well up under cover of the left ribs and the omentum can be thrown upwards from the colon to protect the field of operation. There is no small bowel in the vicinity of the incision. We never drain the peritoneum, but occasionally drain the subcutaneous layer if blood tends to collect there. We suture the abdominal wall with nylon throughout, except for a fine catgut peritoneal suture. The nylon should be tied in a double surgeon's knot, which is secure and lies flat.

We have not been free from herniation in midline incisions, and have reverted recently to a high, roughly transverse, incision, curved with its convexity upwards, or a double Kocher. Our anæsthetists think that this is, as a generality, preferable as a prophylactic against chest complications. We are not satisfied that we have as yet found the answer to the problem of the incision, but we are firmly wedded to nylon as the suture material for aponeurosis as well as skin.

IMMEDIATE POST-OPERATIVE PERIOD

Intravenous fluid, adequate sedatives, Ryle's tube, bed exercises, and early ambulation are the five main points in the early post-operative period. The patients return to bed with one pillow only, and have the foot raised on blocks for twenty-four hours, to lessen venous stasis in the legs and pelvis. Breathing and leg exercises are carried out from the beginning and continued until the patient gets up, usually about the third day. We regard this as late and get them up on the first or second post-operative day for a few minutes if the drip is down. Previously we liked the drip in the leg, but now we favour the arm because of this preference for early ambulation.

Sterile water in limited but measured amounts is allowed by mouth from the beginning, on the understanding that the stomach is kept empty by regular aspiration of the Ryle's tube. This is retained as long as the amount withdrawn exceeds the amount taken. As soon as a positive balance in favour of the patient is recorded the tube is withdrawn.

We judge that the normal intestinal gradient has become re-established when fluid is retained by mouth and when intestinal movements are active and productive of flatus by the rectum. The usual remedies, the flatus tube, the enema, pituitrin, etc., are made use of according to requirements. Thereafter, the amount of fluid taken is increased and we pass from water, through half-strength citrated milk, to junkets and custards, and so to thin bread and butter and a broken egg at about a week to ten days after operation.

COMPLICATIONS

Once the Ryle's tube has been withdrawn, the resident and nursing staff must be alive to the possibility of acute dilatation of the remaining stomach. This causes collapse, with a rapidly rising pulse-rate and respiratory distress. Whenever in doubt, the Ryle's tube should be re-inserted as a first step and fluid replacement and supportive treatment instituted when the diagnosis is confirmed.

Careful avoidance of gastric distension is an insurance against rupture of the duodenal stump. Should this accident occur, however, it should be clearly recognized, so that immediate steps may be taken. The cardinal sign is abdominal pain, which may be generalized from the start or may have a central or right upper abdominal and thoracic distribution if, to any extent, the leak is localized to the subphrenic region. The attack may easily be mistaken for a fulminating basal pneumonia. Circulatory collapse develops quite quickly and intervention must be early if it is to avail. The wound should be re-opened and the region of the stump exposed as expeditiously as possible. If the diagnosis is confirmed by the findings, a wide split tube should be passed down to the duodenum and continuous suction should be instituted through a smaller, loosely fitting tube or catheter which allows free circulation of air down to the bottom of the wound. Supportive treatment and fluid replacement are also needed. Probably thirty per cent of leaks can be saved in this way. Resuture is impossible.

Bleeding should be fully controlled, but may be troublesome, especially in cases of secondary gastrectomy, in which there seems to be established a collateral circulation which is not controlled by ligation of the usual arteries. If intraperitoneal bleeding is observed, the abdomen should at once be re-opened. If there is severe bleeding into the stomach, preventing successful aspiration through the Ryle's tube, the field of operation should also be gone over again. If possible, the stoma should be brought up into the wound, clamps re-applied, and the suture line broken down and re-done. During this procedure, clots should be removed from the stomach and precautions should be taken against the inhalation of blood and clots, which may be forced up the œsophagus. This is a very important precaution.

LATER MANAGEMENT

After subtotal gastrectomy it is an easy matter to ensure freedom from dyspepsia. The greater difficulty appears to be in avoiding nutritional disturbance. Oddly enough, this is less of a problem in duodenal cases than in cases of gastric ulceration, and our experience is that the cases under review have come to no harm either in regard to dyspepsia, nutritional failure, or anæmia, provided an adequate operation has been done. It is, however, our impression that the patients who have adhered strictly to an ulcer régime after operation have progressed less favourably than those who have, by comparison, indulged themselves. It is, therefore, now our practice to advise a full well-balanced diet with a minimum of restrictions. We simply say that a little of everything is needed, that meals should be frequent and small rather than big and spaced, that excesses of all kinds should be avoided, and that all food should be chewed thoroughly, slowly, and deliberately—this to avoid the risk of a large unbroken bolus passing into the jejunum and causing obstruction.

Although such a large fraction of the stomach is removed, anæmia has not been a sequel in any of the cases under review, and it has recently been stated by one observer (Monro, 1945) that he has never seen a case of macrocytic anæmia following partial gastrectomy. A number of patients are now under observation after *total* gastrectomy and it will be interesting to see how the blood and marrow pictures change in this circumstance. Our own method has been to encourage our patients to take a fair amount of suitably cooked and varied meats in the belief that this will help to guard them against anæmia. Occasionally we have prescribed liver or stomach extracts for various periods, but this has not been a routine practice, even in the immediate post-operative period, where it is, apparently, most needed.

THE BLOOD-PICTURE AFTER SUBTOTAL GASTRECTOMY

(*In* 21 *Unselected Cases*)

Case No.	*Pre-operative* Hb %	R.B.C.s	*Interval* Years	*Post-operative* Hb %	R.B.C.s
80	—	— mil	3	80	4·27 mil
85	85	4·4 mil	2	90	4·68 mil
183	—	— mil	3	90	5·05 mil
79	60	2·7 mil	4	74	4·2 mil
202	—	— mil	3	100	5·05 mil
84	80	4·35 mil	3	80	4·25 mil
87	80	4·5 mil	3	85	4·3 mil
185	80	3·45 mil	1	85	4·4 mil
75	—	— mil	3	75	4·26 mil
71	80	4·3 mil	1	85	4·5 mil
13	70	— mil	3	75	4·6 mil
88	70	3·8 mil	4	78	4·7 mil
83	80	4·74 mil	2	80	4·38 mil
72	35	2·32 mil	2 (transfused)	88	5·0 mil
68	50	2·05 mil	3 (anæmia treated)	85	4·38 mil
73	80	4·5 mil	4	85	4·5 mil
77	85	4·6 mil	2	78	3·95 mil
78	—	— mil	5	80	4·3 mil
76	88	4·8 mil	3	90	4·72 mil
187	76	5·2 mil	3	85	4·7 mil
124	—	— mil	3	85	4·5 mil

The average hæmoglobin before operation = 73 per cent
The average R.B.C.s before operation = 3·7 mil
The average hæmoglobin after operation = 83·5 per cent
The average R.B.C.s after operation = 4·5 mil
No case investigated shows the development of any degree of anæmia. Most cases show a very considerable improvement in the blood-picture.

A more thorough study of the blood-picture after operation might be made profitably, but our clinical impression is well borne out by the counts which have been done in the few non-selected cases which are reported here. Our experience suggests beyond all reasonable doubt that the post-operative anæmias of the past (and of the present day, where they exist) should be attributed to unsuccessful operations with recurrent ulceration.

Avitaminosis may be a danger, and if the diet is at all deficient suitable concentrates should be given. Attention has already been drawn to the desirability of an adequate level of vitamin C before operation, to ensure sound healing and to guard against breaking down of the abdominal wall, in particular.

SUMMARY

1. We have discussed and, we believe, made out a case for operation in resistent duodenal ulcer. We have also discussed fully the indications for operation.

2. This argument is based on a wholly personal experience in 363 patients, all of whom were submitted to operation. A variety of operations were performed and a number of patients had several operations. In 363 cases there were 5 post-operative deaths.

3. All the operations were done in the ten-year period 1935–44, and for reasons explained in the text only 200 have been traced in our recent surveys. Although this number is apparently inadequate, we have found such a striking contrast in the late results following different types of operations that we feel justified in drawing very definite conclusions.

4. After subtotal gastrectomy the satisfactory results are so near to 100 per cent of the cases that we now feel justified in recommending the operation with the maximum confidence and a minimum of the guarded reservation with which it has in the past been necessary to approach the subject.

5. From our results we have drawn certain definite conclusions concerning the physiology of the stomach and the steps which it is necessary to follow in order to be sure of achieving a good result.

6. We have described in some detail our own pre-operative, operative, and post-operative procedures. We recognize that there are alternatives and thought it advisable to make our meaning perfectly clear even to the extent of possibly tedious detail.

7. We have emphasized that in spite of the low mortality recorded, this is neither a very easy nor a very safe operation and that it should only be attempted under the best conditions. We recognize that in particular we have been fortunate in our anæsthetists and our anæsthetics and that this has been an important factor in keeping down the dangerous chest complications.

8. Finally, our thanks are due and are freely offered to all those residents, sisters, and nurses, too numerous to mention by name, whose devotion to duty is so essential wherever work of this hazardous character is undertaken.

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SOME INTERESTING GASTROJEJUNAL LESIONS

BY JAMES MORONEY, LIVERPOOL

APART from stomal ulceration, gastrojejunal lesions are uncommon and the following three cases illustrate some of the lesions which occur in this area. I was fortunate to secure the accompanying photographs of the living pathology.

RETROGRADE JEJUNOGASTRIC INTUSSUSCEPTION

CASE REPORT

HISTORY.—A man, aged 50, was awakened by severe upper abdominal pain on May 20, 1946, and an hour later vomited a pint of blood. In 1940, an operation for a perforated peptic ulcer had been undertaken, and at the same time a posterior gastro-enterostomy performed. Since then, he had been symptom free.

He was admitted to the medical ward of the hospital, and on the day of admission he vomited a further three pints of blood. He was transfused with five pints of blood and two pints of blood-plasma.

His condition improved until 7 p.m. on May 21, when he had a further hæmatemesis of one-and-a-half pints. Blood transfusion was continued, but the bleeding persisted.

I first saw the patient on May 22. He was very collapsed and the vomited material was fæcal in type. The whole outline of the stomach was obvious on inspection of his abdomen and was easily palpable below the umbilicus. It was impossible to empty the stomach by means of a Ryle's tube. It was decided to open the abdomen after a rapid transfusion of five pints of blood.

OPERATION.—Local anæsthesia 1 per cent planocain and gas and oxygen. The distended solid stomach filled almost the whole abdomen. A diagnosis of a retrograde gastrojejunal intussusception was made. Reduction was impossible. The anterior wall of the stomach was opened through a small incision between the greater and lesser curvatures. A large amount of blood-clot was evacuated and the appearances after this had been completed are illustrated in *Fig.* 413. The apex of an enormous intussusception was delivered (*Fig.* 414). Resection was performed. The specimen is shown in *Figs.* 415, 416.

FIG. 413.—Intussusception in the stomach, opened through an incision on the anterior wall.

FIG. 414.—Intussusception delivered.

The original gastro-enterostomy stoma was correctly placed and normal in every way.

AFTER-HISTORY.—The patient died four days later.

POST-MORTEM EXAMINATION (Dr. W. K. Taylor).—

Thorax: Both lungs showed marked œdema. All chambers of the heart were dilated. Flabby myocardium.

Abdomen: The recent suture lines showed slight sepsis but were intact. The stomach and duodenum were slightly distended. The kidneys showed coarse cortical markings and fatty medullary replacement.

Cause of Death: Cardiac failure, toxæmic in origin.

Comment.—Of all the causes of hæmatemesis, retrograde intussusception must be amongst the rarest—so rare that it is unlikely ever to be seriously considered.

The essential lesion, which is a high and dangerous intestinal obstruction, was masked by the profuse hæmatemesis. The result was that surgery was delayed until sixty hours from the onset of symptoms.

Careful search of the abdomen and of the specimen failed to reveal any causal mechanism of the lesion.

FIG. 415.—Intussusception. Resected specimen.

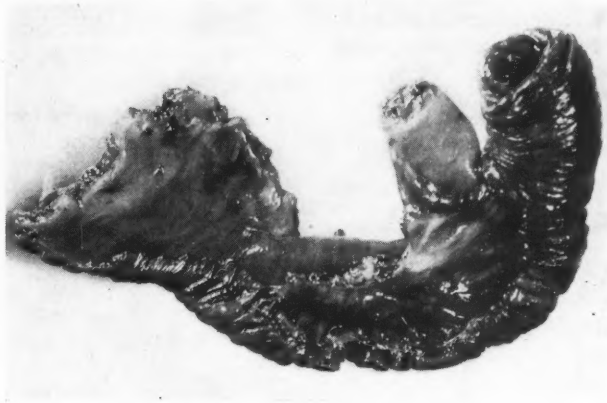

FIG. 416.—Specimen opened.

HOUR-GLASS CONTRACTURE OF THE STOMACH ASSOCIATED WITH CONGENITAL DIVERTICULOSIS OF THE JEJUNUM

CASE REPORT

HISTORY.—A small thin woman, aged 51, attended the out-patient clinic with a history of peptic ulceration for thirty years. During the last six months there had been considerable loss of weight.

INVESTIGATIONS.—Barium meal (*Fig.* 417) revealed an ulcer on the lesser curvature of the stomach with an hour-glass contracture. The stomach emptied normally. Multiple jejunal diverticuloses. Fractional test-meal revealed a marked hyperchlorhydria. After two weeks of strict medical treatment, the patient's condition had improved considerably and operation was undertaken.

OPERATION (Jan. 2, 1947).—A subtotal gastrectomy was performed. The condition of the jejunum is shown in *Fig.* 418. The first diverticulum was situated 2 in. beyond the site of the gastrojejunal anastomosis. The diverticulosis extended for about 3 ft. from this point. Beyond the last diverticulum shown in *Fig.* 418 there were no further diverticula in the intestinal tract.

AFTER-HISTORY.—Ten days later the patient developed a left-sided pulmonary embolism, from which she recovered, but developed a further embolism on the eighteenth day. From this she also recovered and was discharged on Feb. 17. The chest condition showed complete resolution. She was seen again nine months later and, although she had not gained weight as rapidly as one would have wished, she was symptom free and feeling well.

Comment.—The absence of diverticulosis in the first seven to eight inches of the jejunum was fortunate because a subtotal gastrectomy was

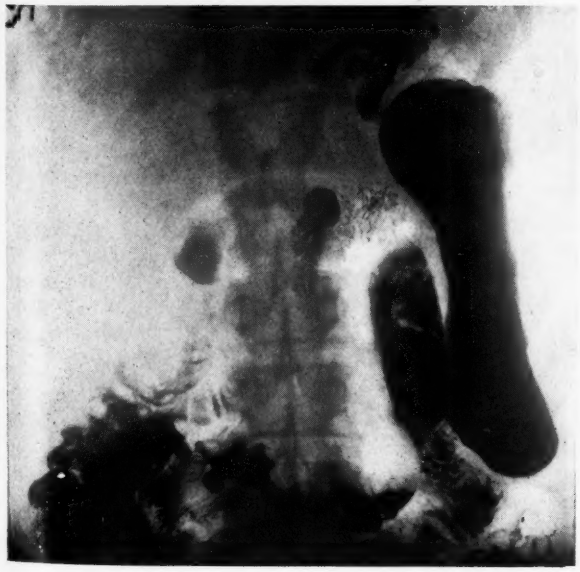

FIG. 417.—Barium meal. Illustrating hour-glass contracture of stomach. Multiple jejunal diverticula.

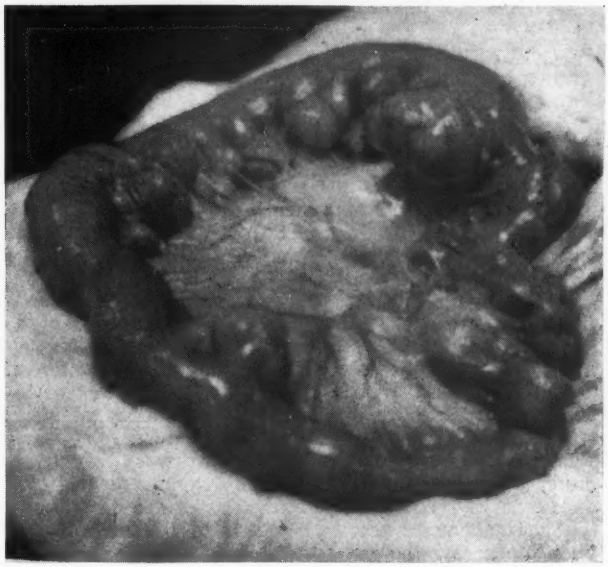

FIG. 418.—Condition of jejunum at operation. The gastrojejunal anastomosis has been completed.

necessary. Clinically, the diverticula do not seem of great significance, although I am inclined to think that the failure to gain weight rapidly may be attributable to their presence. They are probably congenital and, as a glance at the photograph shows, arise from the mesenteric border of the bowel.

GASTROJEJUNOCOLIC FISTULA

This case is recorded briefly, not because the lesion is rare, but because the condition was a severe one and simple exclusion of the colon was sufficient to effect complete relief.

CASE REPORT

HISTORY.—The patient, a man aged 56, had had a gastro-enterostomy performed nine years previously. For eight months prior to the operation he had complained of severe diarrhœa associated with considerable loss of

FIG. 419.—Barium enema before operation.

weight. He had no pain and his appetite was excellent, but his general condition was poor. A radiograph following a barium enema is shown in *Fig.* 419.

OPERATION.—The abdomen was opened through the previous midline incision. The patient collapsed before any procedure was possible and the abdomen had to be closed.

After two weeks' treatment, including several transfusions of blood-plasma, it was decided to re-open the abdomen and the anæsthetist advised that about half an hour's anæsthesia was as long as the patient would survive.

The incision was re-opened. A posterior gastro-enterostomy had been performed for a duodenal ulcer, which had infiltrated the pancreas. The fistulous area was extensive. The transverse colon was divided on either side of the stoma. It was resutured by end-to-end anastomosis. The ends left on the fistula were closed. To gain adequate access, a transverse incision had to be made across the left rectus.

The patient's condition was very poor at the end of the operation and active resuscitative methods were necessary for nearly twelve hours. After this, the patient had an uneventful convalescence. First-intention healing was secured and the patient discharged with advice to return in two months for partial gastrectomy.

AFTER-HISTORY.—The patient gained in weight very rapidly but would not consent to a partial gastrectomy. Nearly eighteen months later, when seen again, he was fit and well.

FIG. 420.—Barium enema after operation.

A radiograph following a barium enema four months after the operation is shown on *Fig.* 420, that following a barium meal in *Fig.* 421.

FIG. 21.—Barium meal after operation.

Comment.—The severe undernutrition in this case made the operation a particularly perilous one. Simple exclusion has given an excellent short-term result.

THE SURGICAL TREATMENT OF ANASTOMOTIC ULCER
AN ANALYSIS OF THIRTY-EIGHT CASES

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It is now more than sixty years since Wolfler (Ginsburg, 1916) described the first anastomotic ulcer. In 1918 Wright was able to collect from the literature the reports of 165 cases; but in 1928 Lahey and Jordan stated that nearly 1000 instances of anastomotic ulceration had been published. A few years later Wright (1934–5) collected 458 cases which had been treated in a group of British hospitals during the years 1923–32; and Lahey and Swinton (1935) found that between the years 1928 and 1934 no less than 1089 cases had been recorded in the literature. To-day this complication of the surgical treatment of simple ulcers of the duodenum and stomach remains as a grave misfortune for the patient, and a serious surgical problem. It is in an attempt to help in the elucidation of this problem that this report, based upon 38 cases of anastomotic ulcer which have been operated upon by Professor John Morley, is advanced.

THE AETIOLOGICAL BASIS OF SURGICAL PROCEDURES

According to the standard text-books of surgical pathology (Boyd, 1947; Illingworth and Dick, 1945), and to judge from the surgical literature, anastomotic ulceration is fundamentally similar to 'peptic' ulceration as a whole. There are seven main groups of hypotheses concerning the formation of 'peptic' ulcers: the neurogenic, the vascular, the chemical, the mechanical, Rosenow's specific bacteria, the ulcer diathesis, and the inflammatory, excluding those postulating endocrine dysfunction and 'rests' of intestinal mucosa in the stomach and duodenum (McCann, 1929; Cushing, 1932; Wilbur, 1936; Dragstedt, 1942; Illingworth and Dick, 1945; Boyd, 1947). The chemical and mechanical hypotheses were early in attracting surgical attention with regard to anastomotic ulceration. It was suggested in 1909 by Paterson that the jejunal type of anastomotic ulcer was due to the presence of free hydrochloric acid in a part of the intestine the contents of which were normally alkaline; and in 1910 experiments were carried out by Wilkie to demonstrate that two mechanical factors, trauma to the gut wall, and the use of non-absorbable sutures, were important in the formation of the gastrojejunal type. In recent years, however, the chemical hypothesis, in varying forms, has become progressively more influential regarding all forms of 'peptic' ulceration, due mainly to the experimental work of Mann (1923, 1927, 1931, 1932) and his collaborators, and that of his followers. In fact the tendency has been for the vascular and mechanical processes to assume the role of agents, whose task it is to destroy, locally, the natural resistance of the bowel wall to the action of the acid gastric juice; and for the neurogenic factor to take up its position as the fundamental cause of an increased motor activity leading to submucous hæmorrhage, vascular spasm, and, most important of all, an excessive production of hydrochloric acid and pepsin. Thus the suggestion of Cushing (1932) that the various hypotheses might be 'harmonized' has been given substance. What Mann and his co-workers demonstrated was that the only reliable experimental method of producing chronic, indurated, ulcers, that were indistinguishable from 'peptic' ulcers in human beings, and which behaved in a similar manner, was to expose the mucosa of the jejunum to the continuous activity of the un-neutralized acid secretion of the stomach. This work has been amply confirmed (Morton, 1927; Ivy and Fauley, 1931; and others) and is the cornerstone upon which the huge amount of experimental work which has now been done on the aetiology of 'peptic' ulcer is founded. Obviously these studies are of particular importance with regard to anastomotic ulceration, because these experimental ulcers are all jejunal ulcers, and produced by a method which seems to exclude the neurogenic, vascular, bacterial, and inflammatory factors. Moreover, as the animals employed do not develop 'peptic' ulcers spontaneously, an ulcer-forming diathesis can be excluded also. There would seem to be little room for doubt, therefore, that in human beings the jejunal type of anastomotic ulcer is caused by the chemical action of the acid gastric juice on the jejunal mucosa; especially when this experimental evidence is joined to such clinical evidence as the almost complete absence of any form of anastomotic ulcer following a gastroenterostomy in cases of carcinoma of the stomach (Wright, 1934–5; Eustermann and Balfour, 1936), its greater frequency in cases of duodenal than gastric ulcer, and the formation of 'peptic' ulcers in those Meckel's diverticula which contain ectopic acid-secreting gastric mucosa (Lindau and Wulff, 1931; Morley, 1946). Indeed the hold exerted by the chemical hypothesis with regard to anastomotic ulcer is now so strong that the gastrojejunal type of this condition attributed partly to the use of non-absorbable sutures has tended to lose its separate identity. Eustermann and Balfour (1936), for example, explicitly reject the idea that the gastrojejunal ulcer is a separate entity, and claim that all anastomotic ulcers start in the jejunum, but add that some extend to involve the stoma and may even spread into the stomach. This trend of opinion is probably due, particularly, to the experimental work of Scott (1929), and others, who demonstrated that even if the Mann and Williamson preparation was executed with non-absorbable sutures, the ulcers still formed in the jejunum distal to the suture line. Moreover, it must be admitted that the widespread conversion of surgeons to the use of catgut has not abolished the occurrence of anastomotic ulcers. With the passage of time, therefore, surgeons have become progressively more certain with regard to the causative role played by the acid gastric juice in the formation of anastomotic ulcers of both types.

Excluding the treatment of acute perforations, the early operative procedures can be divided into three groups: those in which a simple excision of the anastomotic ulcer was carried out, with or without a refashioning of the stoma; those in which the normal anatomy was restored; and those which sought to overcome the problem presented by the low 'natural resistance' of the jejunum to the acid gastric juice. It is not surprising to find that the first of these three alternatives was a failure, as was pointed out in his survey by Wright (1934–5). Moreover this authority stated that the restoration of the normal anatomy achieved the relief of symptoms in only 20 per cent of cases, and that frequently it led to the re-activation of the original duodenal ulcer. Reports of this re-formation of the duodenal ulcer are numerous (Lahey and Jordan, 1928; Rowlands, 1928; Shore, 1928; Lewisjohn, 1930; Ginzburg and Mage, 1938; Finsterer, 1939). There are only four examples of this surgical procedure in the present series; and of the two cases which have been traced both suffered from the re-formation of the original duodenal ulcer within a year of the restoration of the normal anatomy and underwent further operative treatment. This sequence of events is of great aetiological importance because it demonstrates clearly the identity of nature between duodenal and anastomotic ulcers; and confirms the view that the main causative factor must be the action of the acid gastric juice in each case, because the only thing that has been altered is the point at which the contents of the stomach enter the small bowel. It might be regarded, therefore, as a rather gross example of the experiment performed by Mann and Bollman (1932) which demonstrated that the site of the ulceration, which coincided with the point where the 'jet' of gastric contents struck the bowel wall, could be altered at will by changing the direction of the 'jet'. Nevertheless Balfour (1935) recommends the restoration of the normal anatomy in those cases in which the original ulcer has healed without stenosis of the pylorus, a procedure which would appear to rest upon the hope that somehow the cause of the original ulcer has vanished meanwhile. This view cannot be accepted, especially as this operation, according to Wright (1934–5), is attended by a high mortality. The results of the third group of procedures has been no more successful than the others, and there are no examples in this series. The object of this last group of operations was to avoid restoring the normal anatomy, yet to try and minimize the difficulty presented by the sensitivity of the jejunal mucosa to the acid gastric juice; a sensitivity which has now been demonstrated experimentally by Mann and Bollman (1932) and by McMaster (1933), and shown to increase as the ileocæcal junction is approached. Wright (1918–19), in his first survey, therefore suggested that the original gastro-enterostomy should be undone and replaced by a gastroduodenostomy or by a Finney's pyloroplasty, to direct the gastric contents on to the more resistant duodenal mucosa. If this could not be achieved and there was an anterior antecolic gastro-enterostomy, or a Roux anastomosis, it should be converted into a posterior 'no-loop' retrocolic anastomosis. In his later paper Wright (1934–5) reported that the results of changing the type of gastro-enterostomy were no better than those for the restoration of the normal anatomy. Indeed there seems to be very little reason why they should be any better; and it is interesting to note that Ginzburg and Mage (1938) in their series of anastomotic ulcers found several instances in which, following the addition of a second anastomosis, ulceration had developed on the new stoma as well. A similar sequence of events was published by Thompson and Stewart (1928). It is evident that to divert the acid gastric juice on to an area of mucosa with a slightly higher natural resistance, in a person whose duodenal mucosa has already shown its weakness, is quite inadequate; especially as gastro-enterostomy, as a whole, is a very unreliable way of depressing the gastric acidity (Lewisjohn and Feldman, 1925; Holman and Sandusky, 1938; Heuer and Holman, 1943; Wangensteen and Lannin, 1942).

As all the foregoing types of procedure are unsatisfactory, only one alternative remains—to try and depress permanently the acid gastric secretion. To achieve this object it was suggested by Moynihan (1919) that the correct procedure was a partial gastrectomy to overcome the "persistent hyperchlorhydria" of the stomach. A similar view was put forward by Balfour (1926), which he later modified. In recent years, however, an increasing number of surgeons have been advocating the use of partial gastrectomy in the treatment of anastomotic ulcer (Lewisjohn, 1930; Walton, 1934–5; Ginzburg and Mage, 1938; Finsterer, 1939; Fallis and Warren, 1946), and this is the operation which has been employed in nearly all of the present series; the main advantage of partial gastrectomy being that, up to the present, it is the only reliable way of permanently depressing the acid gastric secretion. Other methods have been introduced in recent years; the extensive resection of the acid-secreting part of the stomach (Connell, 1934, 1939; Seely and Zollinger, 1935; Zollinger, 1940); and the resection of the vagi (Dragstedt and Schafer, 1945; Dragstedt and others, 1947; Thompson and James, 1947; Grimson and others, 1947); but it is too early yet to assess their value. The next step in this discussion, therefore, will be to examine the clinical results achieved by partial gastrectomy in the treatment of anastomotic ulceration.

THE CLINICAL RESULTS OF PARTIAL GASTRECTOMY

In the present series 26 antecolic Polya partial gastrectomy operations were carried out on 25 patients; 8 partial gastrectomies by Finsterer's method, using a prepyloric section, were performed on 5 patients; and 4 patients were treated by means of a Schoemaker operation. In addition 2 cases had a Devine's exclusion, without the removal of any part of the stomach, which will be considered separately; making a total of 36 patients and 40 operations. The 2 remaining cases in which the normal anatomy was restored, and upon whom no further operations were carried out, will not be discussed further.

As far as sex and age are concerned the present series does not reveal any variation that might affect the evaluation of the results that have been obtained: Eustermann and Balfour (1936), for example, basing

their opinion on a very large series, state that the average age is 42 years, with a range of 15 to 74 years of age. *Fig.* 422 shows that the age distribution of the present series is of a similar type, with the majority

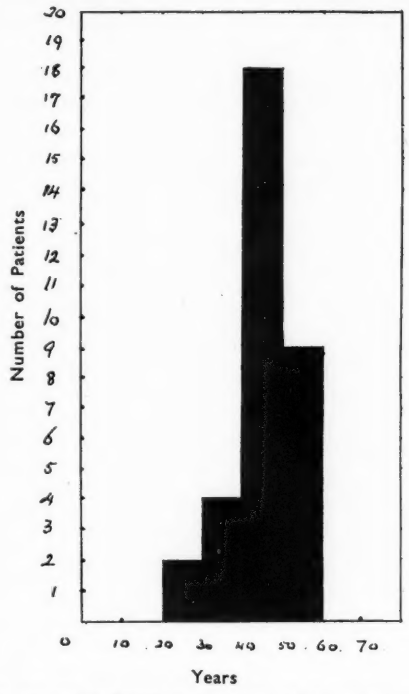

FIG. 422.—Age distribution of the patients in the present series.

of cases in the fifth decade. These authorities give the ratio of males to females as 10 : 1 (248 males to 22 females), and *Table I* demonstrates that most of

Table I.—THE SEX RATIO OF THE PATIENTS IN THE PRESENT SERIES COMPARED WITH THAT OF THE PRINCIPAL PUBLISHED REPORTS

AUTHOR	YEAR	MALE	FEMALE	RATIO
Paterson, H. J.	1909	39	11	3·6 : 1
Wright, G.	1918	113	27	4·2 : 1
Judd, E. S.	1921	90	11	8·2 : 1
Hurst, A. F., and Stewart, M. J.	1928	37	6	6·2 : 1
Lahey, F. H., and Jordan, S. M.	1928	14	2	7 : 1
Benedict, E. B.	1933	35	1	35 : 1
Vanzant, F. R., and others	1933	174	14	12·4 : 1
Wright, G.	1934	410	40	10 : 1
Walton, A. J.	1934	72	7	10·3 : 1
Eustermann, G. B., and Balfour, D. C.	1936	248	22	11·3 : 1
Grossman, A.	1938	20	3	6·7 : 1
Ginzburg, L., and Mage, S.	1938	76	2	38 : 1
Fallis, L. S., and Warren, K. W.	1946	9	1	9 : 1
Present Series	1947	36	2	18 : 1

the published reports conform approximately with this estimate, the present series, however, showing an even greater preponderance of males, with a ratio of 18 : 1. Similarly, in the present series, most of the original lesions had been duodenal ulcers—31, as opposed to only 1 gastric. In the remaining 6 cases the original lesion was either not recorded or not clearly located. This preponderance of duodenal ulcers is in conformity with other writers: Wright (1934–5) found 344 duodenal, as against 106 gastric ulcers; Balfour (1926) 130 duodenal to 9 gastric; Grossman (1938) 21 duodenal out of 23, and Ginzburg and Mage (1938) no gastric ulcers at all in a series of 78 anastomotic ulcers. Last, it is interesting to note that in 2 cases of the present series the fractional gastric analysis (gruel meal with no histamine injection) revealed a very low level of free acid, the highest level, in both instances, being below ten units of decinormal units of HCl. This observation is in conformity with that of Balfour (1926) to the effect that some cases of anastomotic ulcer may show no free acid on ordinary testing; and the demonstration by Vanzant and others (1933) that in some cases the level of free acidity was below normal.

The clinical assessment of the results obtained in the present series has been made on the following basis:—

Grade I. Complete freedom from gastric symptoms.

Grade II. Intermittent mild attacks of pain controlled by medical treatment; and the 'postcibal' syndrome. Little or no interference with daily life.

Grade III. Unimproved or worse since operation; severe pain, hæmorrhages, etc.

Grade IV. Definite recurrence of anastomotic ulcer.

Of the 25 patients who underwent a Polya partial gastrectomy, the result is known in 21, 3 having remained untraced and 1 having died several years ago. In 13 (62 per cent) the result was Grade I, in 3 (14 per cent) Grade II; so that in 16 (76 per cent) the result was satisfactory. Only 1 case has been grouped as Grade III, a patient who was operated upon ten years ago and who has complained of persistent pain since; but this evaluation is uncertain because there is evidence to suggest that the basis of his present state is psychological. Only 1 case developed a further anastomotic ulcer which, it is interesting to note, was situated in the afferent limb of the jejunum. This case is also noteworthy because after the Polya operation had been performed he was only free from symptoms for a few months; but since a more radical resection of the stomach was carried out at a subsequent operation in 1944, he has remained asymptomatic, and can now be classed as Grade I. With regard to the operative mortality of this group, there were 3 deaths in 26 operations (11·5 per cent).

In 5 patients it was found necessary to leave the first part of the duodenum in situ and to cut across the prepyloric part of the stomach after the manner of Finsterer. This procedure has led to considerable discussion in recent years, because it leaves behind part of the pars pylorica from which comes the acid-stimulating hormone 'gastrin' (Edkins); moreover, it should be remembered that this hormonal effect

persists even though the pars pylorica is excluded from the alimentary current, as in the Finsterer operation, because it has been shown experimentally that whereas excision of the pars pylorica removes the effect, its transplantation to a remote region, divorced from the gut, does not (Babkin, 1944). Bancroft's suggestion that the antral mucosa should be cored out if any of the pars pylorica is left was an attempt to overcome this difficulty. Gastrin, of course, is

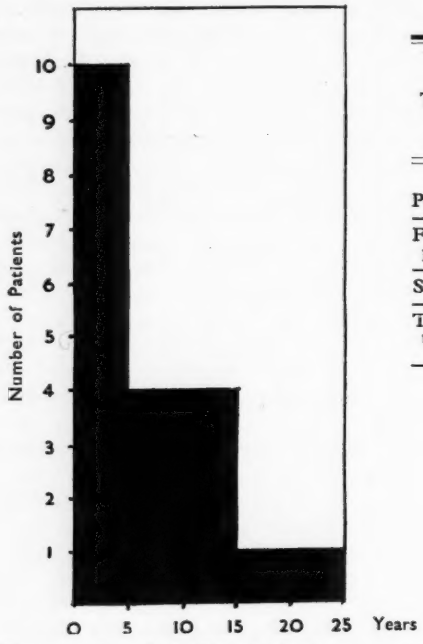

FIG. 423.—Length of follow-up in the present series.

only one part of one of the several phases of gastric secretion, and no surgeon would expect to depress the acidity of the gastric juice by the removal of that phase alone; but experience has shown the danger of leaving the pars pylorica, and the present series demonstrates it clearly. Out of the 5 cases in which this operation was performed, not a single Grade I result was achieved in the first instance; in fact 3 further anastomotic ulcers formed, requiring in each case a more radical resection of the body of the stomach at a subsequent operation. Since this latter procedure two of the cases have remained asymptomatic (Grade I) and the third has been lost sight of. In one of the cases which has been traced, the whole of the body of the stomach, virtually, has now been ablated; and it should be noted that Lannin (1945) has shown experimentally that provided the antral mucosa is removed, and at least three-quarters of the stomach in addition, no jejunal ulcers result. In spite of these additional resections all the 8 operations performed on these 5 patients were completed without a post-operative death.

In this series only 4 patients were treated by a Schoemaker type of partial gastrectomy. The only case that has been traced is asymptomatic (Grade I). One patient died in the immediate post-operative period.

Last, and as if to cast doubt on what has just been said about the pars pylorica, the 2 cases in which a Devine's exclusion was done have both remained free from symptoms for several years. In each case none of the body of the stomach was removed, the distal part, including the original gastro-enterostomy, being left in situ. Suffice it to say, however, that Lannin (1945), who tested this procedure experimentally on dogs, found that multiple jejunal ulcers resulted in each case.

For the sake of comparison the results of the 34 patients upon whom 38 partial gastrectomies (Polya, Finsterer, and Schoemaker) were performed are grouped together in *Table II*. A representative series of results drawn from the literature is given in *Table III*. Last, the length of time that the 20 patients, in the present series, have been followed-up with satisfactory results (Grades I and II) is shown in *Fig.* 423; it is an important piece of evidence which is not infrequently left unrecorded.

Table II.—THE RESULTS OF THE PRESENT SERIES

TYPE OF OPERATION	NO. OF OPERATIONS	OPERATIVE MORTALITY	RESULTS, GRADE I AND II	
			Total Cases	Cases followed-up, excluding Post-operative Deaths
Polya	26	3 (11·5 per cent)	per cent 64	per cent 88
Finsterer: Pre-pyloric section	8	0 (0·0 per cent)	—	—
Schoemaker	4	1 (25·0 per cent)	—	—
Total partial gastrectomies	38	4 (10·5 per cent)	53	83·3

Table III.—A SELECTION FROM THE PUBLISHED RESULTS OF THE TREATMENT OF ANASTOMOTIC ULCER BY PARTIAL GASTRECTOMY

AUTHOR	DATE	NO.	OPERATIVE MORTALITY	SATISFACTORY RESULTS
Balfour, D. C.	1926	89	3 (3·4 per cent)	85 per cent
Lewisjohn, R.	1930	13	6 (46 per cent)	54 per cent
Walton, A. J.	1934	61	16 (25 per cent)	75 per cent
Wright, G.	1934	?	15–20 per cent	60 per cent
Lake, N. C.	1937	27	4 (14·8 per cent)	?
Finsterer, H.	1939	196	24 (12·2 per cent)	78 per cent (Approx.)
Alessandri*	—	—	15·3 per cent	—
Zuckschwerdt Eck*	—	—	14·2 per cent	—

* Quoted by Finsterer, H. (1939).

DISCUSSION

In spite of the fact that a partial gastrectomy is the most reliable way of depressing the acid gastric secretion permanently, as has been noted already, it is not entirely free from the risk of further anastomotic ulceration. This fact was pointed out twenty years ago by Balfour (1926). Numerous examples have been published since that time (Finsterer, 1939; St. John and others, 1939; Walters and others, 1940; Mage, 1942; Kiefer, 1942; Walton, 1944; Fallis and Warren, 1946; Thompson and

James, 1947); and four surgically proved instances (1 Ployа, 3 Finsterer) occurred in the present series requiring further resection. The probable reason for these failures lies in the huge physiological capacity of the stomach to secrete an acid juice, and the numerous sources from which the normal stimuli to that secretion are derived. The details of the manner in which the stomach actually forms hydrochloric acid is as yet unknown, as becomes clear from the description of the contending hypotheses given by Babkin (1944). Nor, for that matter, is it quite certain how the acidity of the gastric secretion is regulated. One thing is known, however, and that is that the acid secreting 'parietal' cells, although grouped chiefly in the body of the stomach, are distributed over the whole gastric mucosa with the exception of the pars pylorica. Babkin (1944) quotes Berger to the effect that, in man, the number of 'parietal' cells in the cardiac and fundic areas are numerous, their density being fully 50 per cent of that existing in the body. Theoretically, therefore, even with a very radical gastric resection it is almost impossible to remove so many 'parietal' cells that the power of the stomach to secrete an acid juice is abolished. Moreover, as has been noted with regard to Finsterer's prepyloric section, the excision of the pars pylorica from which the acid-stimulating hormone 'gastrin' is derived is quite inadequate by itself, because stimuli pass to the 'parietal' cells down the vagi from the brain (psychic phase), they are stimulated directly by food in the stomach, and, as Babkin (1944) also points out, these cells are activated by secretogogues coming from the contents of the duodenum and jejunum (intestinal phase). Last, it is important to note that, according to this authority, the regurgitation of duodenal secretions plays a negligible part in depressing gastric acidity, because their alkalinity is too low to make them a powerful neutralizing agent. He admits, however, that they may act as a diluent. In the surgical treatment of anastomotic ulceration by partial gastrectomy alone, leaving the vagi intact, therefore, it is most important to remove as much of the body of the stomach as possible in addition to the pars pylorica. Experimentally, in dogs, Lannin (1945) has shown that with a Polya resection removing three-quarters of the stomach no jejunal ulceration occurred, whereas if only half was removed ulceration did take place. Even so Keifer (1942) has reported 20 recurrences in a group of 146 duodenal and 27 jejunal ulcers in which three-quarters of the stomach, at least, had been removed. And Mage (1942) has published the occurrence of 40 anastomotic ulcers in a series of 502 partial gastrectomies, removing two-thirds of the stomach for primary duodenal ulcer. There is considerable difference of opinion, moreover, about the degree to which a partial gastrectomy depresses acid gastric secretion (Klein, 1935; Walters, 1936; Winkelstein and Berg, 1938; St. John and others, 1939; Walters and others, 1940). Wangensteen and Lannin (1942), however, have shown that if three-quarters of the stomach is removed 63 per cent of cases become truly achlorhydric (no free acid after histamine); and Heuer and Holman (1943) that the proportion of 'anacidity' is directly proportional to the amount of stomach removed.

CONCLUSIONS

1. At the moment, the correct surgical treatment of anastomotic ulcer is a Polya partial gastrectomy with the removal of at least three-quarters of the stomach.

2. If it is found necessary to perform a prepyloric section (Finsterer) the pyloric mucosa should be cored out, as recommended by Bancroft.

SUMMARY

1. The aetiological basis of current surgical procedures is examined and the identity of nature between duodenal and anastomotic ulcers is affirmed, and the acid gastric juice is accepted as the immediate cause.

2. It is pointed out that, theoretically, partial gastrectomy is the correct treatment of anastomotic ulcer; and this opinion is supported, clinically, by an analysis of the results obtained in the present series.

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AN IMPORTANT ANOMALY OF THE RIGHT HEPATIC DUCT AND ITS BEARING ON THE OPERATION OF CHOLECYSTECTOMY

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" Technically gall-bladder surgery is much the most difficult of any abdominal surgery, and inadequate appreciation of the abnormalities of this region does not lessen the risks."—E. R. Flint, 1923.

THE operative injuries of the common and hepatic ducts make a fascinating chapter in the history of surgical progress. Hans Kehr (1913) made a masterly survey of the subject, and in doing so described nearly every type of abnormality which could be met with in this region of the body. Eisendrath (1920) made a careful review of the recorded cases of operative injuries of the common and hepatic bile-ducts, restudying the reviews on the same subject by Jacobson (1916) and Ellsworth Elliot (1918). He accepted only 33 cases from the records of Jacobson and Ellsworth Elliot as authentic cases of injury to the common and hepatic ducts due to errors of technique or to anatomical variations, and added references to a further 18 cases. Flint (1923) published a paper which reviewed the previous work, and described the findings in 200 dissections on the cadaver of the vessels and ducts of the hilus of the liver. The net result of this work was to emphasize the importance of adequate and full dissection of the ducts and vessels of the portal fissure before commencing the dissection and removal of the gall-bladder in the operation of cholecystectomy.

This paper records the operative findings during the performance of cholecystectomy in two cases of an important anomaly of the right hepatic duct in which this duct opened into the gall-bladder at Hartmann's pouch. In both these cases the left hepatic duct continued downwards as the common hepatic duct, receiving one cystic duct in one case and two cystic ducts in the other. This anomaly of the right hepatic duct is important, in that failure to demonstrate it at the time of operation would have resulted in division of this duct in the gall-bladder bed, with a resultant profuse leak of bile, which might have caused death from bile peritonitis. Even if the patient had survived the hazard of death from bile peritonitis, he would have developed a complete obstruction of the right hepatic duct from cicatrization. The result of such a complete obstruction would be a very interesting problem. Two papers having a direct bearing on this problem are those of Swartley and Weeder (1935) and Weeder (1939), which refer to the same patient observed over a period of more than four years. This patient was operated on in December, 1932, for a choledochus cyst in connexion with the right hepatic duct. The gall-bladder emptied into this cyst and the cyst communicated with the duodenum by a narrow duct representing the distal end of the right hepatic duct. The left hepatic duct was of large dimensions and emptied directly into the duodenum. At operation the cyst was excised with the gall-bladder, and the right hepatic duct was ligatured. Except for transient jaundice of one month, the patient had no symptoms from the ligature of the hepatic duct till January, 1936, when he developed signs suggestive of splenic anæmia, for which splenectomy was done. At the second operation the right lobe of the liver was observed to be atrophied and the left lobe greatly hypertrophied. There was a moderate degree of cirrhosis of the liver. This unique case suggests that ligature of the right hepatic duct might have no greater adverse effect than atrophy of the right half of the liver with compensatory hypertrophy of the left half of the liver.

The opening of the right hepatic duct into the gall-bladder is a rare anomaly and no case was recorded by Kehr, Eisendrath, or Flint. Kehr, however, figures one case in which two hepatic ducts drained into the gall-bladder the cystic duct of which empties into a large common duct opening into the duodenum. The two ducts draining into the gall-bladder are probably right hepatic ducts, while the left hepatic duct probably continues down as the common hepatic duct.

Accessory hepatic ducts opening into the gall-bladder or cystic ducts, have been reported by many observers. Mentzer (1929) states that they were present in 8 out of 96 consecutive necropsies. The ducts are small and easily overlooked, and probably have often been divided at the operation of cholecystectomy without being recognized. Post-operative bile leakage might be due to such ducts more often than to slipping of a ligature on the cystic duct.

It is of interest to consider whether embryology and comparative anatomy throw any light on the nature of these abnormalities. The liver bud is a ventral outpouching from the entoderm. The cranial part of the hepatic pouch proliferates giving solid cell columns which form the liver. The caudal part of the pouch forms the gall-bladder, which subsequently elongates to form the cystic duct at its base. The stalk of the hepatic pouch elongates to form the common bile-duct and the hepatic ducts (based on Arey, 1946). The process of normal development does not therefore explain how the gall-bladder could receive the right hepatic duct or an accessory hepatic duct, nor does it explain why the left half of the liver could drain by a large duct representing the left hepatic duct and the common hepatic duct, while the right half of the liver drains by the right hepatic duct opening either into the gall-bladder or independently into the duodenum. The anomalies could only be the result of an abnormal mode of development of the liver bud. However, reference to comparative anatomy shows that the anomalies described find a parallel in the normal arrangement of the common and hepatic ducts of

many species. The entry of the right hepatic duct into the gall-bladder, with the left hepatic duct opening directly into the duodenum is a condition found in many fish, reptiles, and birds (Mentzer, 1929).

Most writers who have studied the question of the operative injuries of the common and hepatic bile-ducts, have advised that cholecystectomy be performed by commencing the dissection at the cystic duct, and that the bile-ducts be properly exposed before the gall-bladder is removed from the cystic end upwards to the fundus. There are, however, objections to the universal adoption of this technique. In cases in which the gall-bladder is greatly distended, the bulging of Hartmann's pouch so obscures the underlying structures that dissection in the region of the cystic duct cannot be commenced without deflation of the gall-bladder by removal of its contents. In the gall-bladder infected with virulent organisms, this procedure involves a grave risk of spread of infection. The gall-bladder should be treated in the same manner as a distended acutely infected appendix, and it should be removed without having its lumen opened. Removal of the grossly distended gall-bladder under these conditions could only be done by dissection of the gall-bladder from the fundus downwards. There are many reports in the literature of the risks of this method. Traction on the gall-bladder draws the common bile-ducts into a pedicle which is inadvertently divided, causing serious injury to the ducts. However, this danger can be obviated by strict adherence to the cardinal rule that no division be made of the cystic duct till the anatomy of the region has been fully displayed, and once the distended gall-bladder has been mobilized, dissection of the bile-ducts and vessels is readily performed.

The 'fundus down' method was employed in both the cases reported in this paper, and no difficulty was experienced in displaying the anatomy of the portal fissure before the gall-bladder was removed. In the second case there was no cystic duct and the gall-bladder opened directly into the common hepatic duct by a wide orifice. Wakeley (1935) pointed out that the condition was not a congenital anomaly, but was due to the gradual dilatation of the cystic ducts by gall-stones, which ultimately distended the cystic duct to a passage so wide that its lumen was indistinguishable from the cavity of the gall-bladder. Such a condition needs careful closure of the opening into the common bile-duct, as cases have been recorded of operative injuries of the common hepatic duct when this anomaly was encountered (Eisendrath).

CASE REPORTS

Case 1.—A., female Sinhalese, aged 30, married, was admitted to the General Hospital, Colombo, on March 16, 1939, on account of right-sided upper abdominal pain of eight days' duration. She had had two previous attacks of pain of a similar nature. At 8 years of age she had a severe illness with continued fever, which had been diagnosed as typhoid fever.

On Examination.—The patient's temperature was 100·2° and her pulse was 100. The abdomen was soft, but there was a tender mass the size of a lime at the site of the gall-bladder. Cholecystectomy was advised.

Operation (8 a.m., March 17).—Under light percaine spinal anæsthesia. Right upper abdominal paramedian incision. The gall-bladder was thick-walled and white and the omentum was adherent to it. The omentum was separated off the gall-bladder and the gall-bladder dissected from the fundus downward. At Hartmann's pouch two ducts were noted connected with the gall-bladder, and on further dissection the condition depicted in *Fig.* 424 was demonstrated. The common bile-duct was the continuation downwards of the left hepatic duct. The right hepatic duct entered the gall-bladder and there were two cystic ducts.

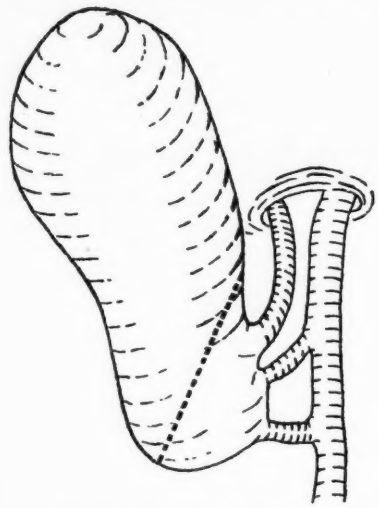

Fig. 424.—The arrangement of the ducts demonstrated at operation in *Case* 1. The site of excision of the gall-bladder is indicated by the dotted line.

The appearance of the gall-bladder showed that it was a chronically inflamed thickened sac, and the history of the case indicated that there had been a recent exacerbation of this inflammation. After careful consideration of the problem raised by the anomalies in the arrangement of the bile-ducts, cholecystectomy was performed at the site indicated by the dotted line in *Fig.* 424. The abdominal wound was closed with a rubber drain leading through it down to the site of the gall-bladder bed. Examination of the gall-bladder removed at operation showed that it had a white fibrosed wall ¼ in. thick. The mucosa was swollen and plum coloured and the lumen contained pus, which was sent for culture.

Progress.—The patient had pyrexia and a rapid pulse for nine days after operation, and there was a discharge of serum from the wound at the site of the drainage tube. After the ninth day the patient made an uninterrupted convalescence.

Pathological Report.—The report on the culture made from the pus was "*B. typhosus* in pure culture". The agglutination test for typhoid was done on the blood-serum on April 13, April 24, and May 1. On all three dates the serum gave a 1/250 positive reaction for *B. typhosus H.* A negative reaction was obtained for *paratyphosus A H* and *Bacillus columbiensis H.* The patient left hospital on May 1 cured of her pain and in good health.

Case 2.—H. M. N., female Sinhalese, aged 20, married, was admitted to the General Hospital, Colombo, on June 5, 1947, at 8.35 a.m. on account of acute abdominal pain of five days' duration. The pain was a dull ache in the right loin and right upper abdomen and was aggravated by the taking of meals. Fever had been present for five days accompanied by vomiting. Bowels had not been opened during the past five days. There had been no previous attacks of similar pain.

ON EXAMINATION.—Her temperature was 98·2° F. and her pulse 84. The abdomen was soft and there was a lump the size of an egg at the site of the gall-bladder. The patient was in great pain, but at first she refused to submit to a surgical operation. At 3 p.m., as the pain had not abated, the patient consented to operation.

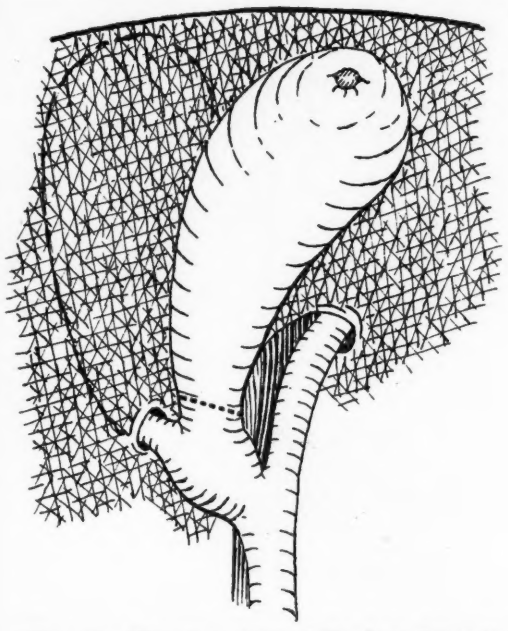

FIG. 425.—The arrangement of the ducts demonstrated at operation in *Case* 2. Hartmann's pouch was thick and scarred. The site of division of the gall-bladder is indicated by the dotted line.

OPERATION (7.15 p.m., June 5).—Under light percaine spinal anæsthesia the abdomen was opened by a right upper paramedian incision. The gall-bladder was glued to the transverse colon by adhesions. On separating these adhesions, pus which poured out of a perforation at the fundus of the gall-bladder (*Fig.* 425) was mopped away. Calculi were palpable in the gall-bladder. Dissection of the gall-bladder was commenced from the fundus downwards. A large duct was seen entering the gall-bladder at its lower end and, on further dissection, the condition depicted in *Fig.* 425 was disclosed. The left hepatic duct was directly continuous with the common bile-duct. The right hepatic duct entered the gall-bladder at Hartmann's pouch. The cystic duct was absent, the thickened fibrosed Hartmann's pouch opening directly into the common bile-duct. Cholecystectomy was performed at the site indicated by the dotted line in *Fig.* 425. The gall-bladder bed was reperitonized and the abdominal wound closed, the site of operation being drained through a stab wound in the right loin. The gall-bladder contained three faceted cholesterol stones the size of cherries.

Apart from some pyrexia for six days after operation the patient had no post-operative trouble and left hospital on June 19.

Culture of pus from gall-bladder: *B. coli* and *Staph. albus* were isolated.

DISCUSSION

The operative procedure adopted for the two cases reported in this paper was thought out for the first time during the performance of a cholecystectomy in the first case. The results were gratifying, both patients making an uneventful recovery from their operations. Although the anatomical anomaly for which the operation was planned is one of great rarity as judged by reports in the literature, the operation has a wider applicability in that it could be performed for the less rare cases in which a large accessory bile-duct opens into the gall-bladder.

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OCCULT BONE METASTASES

By RALPH SHACKMAN AND C. V. HARRISON

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IT is a generally accepted rule—although there are exceptions—that distant spread precludes the use of surgical excision as the method of treatment for malignant disease, and the criteria which are accepted as a basis for such a decision are dependent on clinical and radiological findings. Follow-up records, however, often reveal the fallacies of this evidence and the subsequent appearance of distant metastases emphasize the limitations of these diagnostic methods.

It is sometimes said that metastases 'develop'. By this it is implied—or so it would seem—that distant spread is microscopical at the time of operation on a primary tumour and that the later radiological signs of metastases result from subsequent proliferation of tumour tissue. In a standard text-book of surgery (Romanis and Mitchiner, 1944), it is stated that " an examination must be made to ensure that metastases are not present—their favourite sites being the spine and other bones. Rarely, a diffuse infiltration occurs and the X-ray shows generalized rarefaction affecting primarily the long bones near the trunk, or a localized metastasis reveals rarefaction due to caries ". Similarly, it is current teaching to request an X-ray examination of the spine and chest before advising a patient suffering from cancer of the breast to submit to surgical treatment, and a recent text-book on radiology of bones and joints (Brailsford, 1944), states, " before conducting operative procedures for the removal of carcinomata, it is advisable to radiograph the pelvis and spine for evidence of secondary deposits ". The constant use of radiographs to demonstrate bony metastases is liable to lead to an unwitting and

erroneous conclusion that a so-called normal radiograph indicates the absence of bony metastases. But thoughtful consideration should convince one that such an assumption is unjustified, and although

In the course of routine autopsies we have been struck by the discrepancy between recent X-ray reports and the anatomical findings. Careful examination of the skeleton at post-mortem with a hand

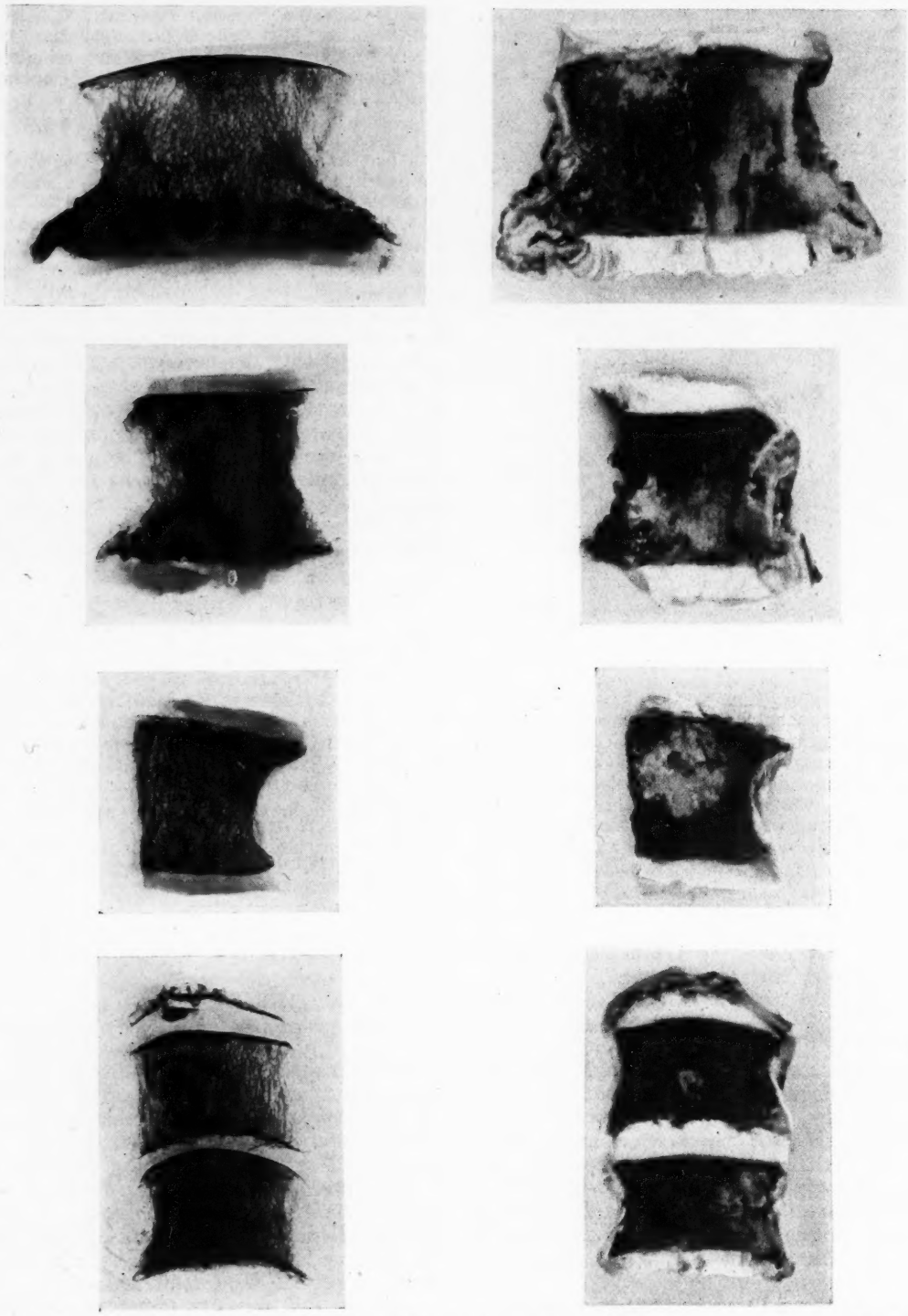


FIG. 426.—*Case* 1. The right-hand column consists of five vertebræ, each containing an obvious metastasis. The left-hand column shows the radiographs of these pieces of bone: all apparently normal.

we do not think that such rationalization is accepted by all, we do suggest that it is not generally realized how extensive bony metastases can be without there being any demonstrable radiological abnormality.

lens, and later by microscopy, has shown that metastatic tumour tissue may fill the marrow spaces and yet leave the bony architecture unaltered. This is not a new observation. Willis (1934) states

"almost always, blood borne metastatic growths in bones are situated initially in the bone marrow," and he notes that such metastases occur most frequently in the bones containing red marrow. True bony change is secondary to the presence of cancer cells in the neighbourhood and can be likened to the stromal reaction excited by cancer cells in other situations. The actual alteration in the bone is effected by the cells of the bone—the osteoblasts and osteoclasts. In view of this it is to be expected that radiologically visible bone changes will occur only after the marrow spaces have been infiltrated and probably filled. To test this view we have taken specimens of bone from autopsies on patients dead of malignant disease with distant bony metastases and selected those specimens which showed naked-eye

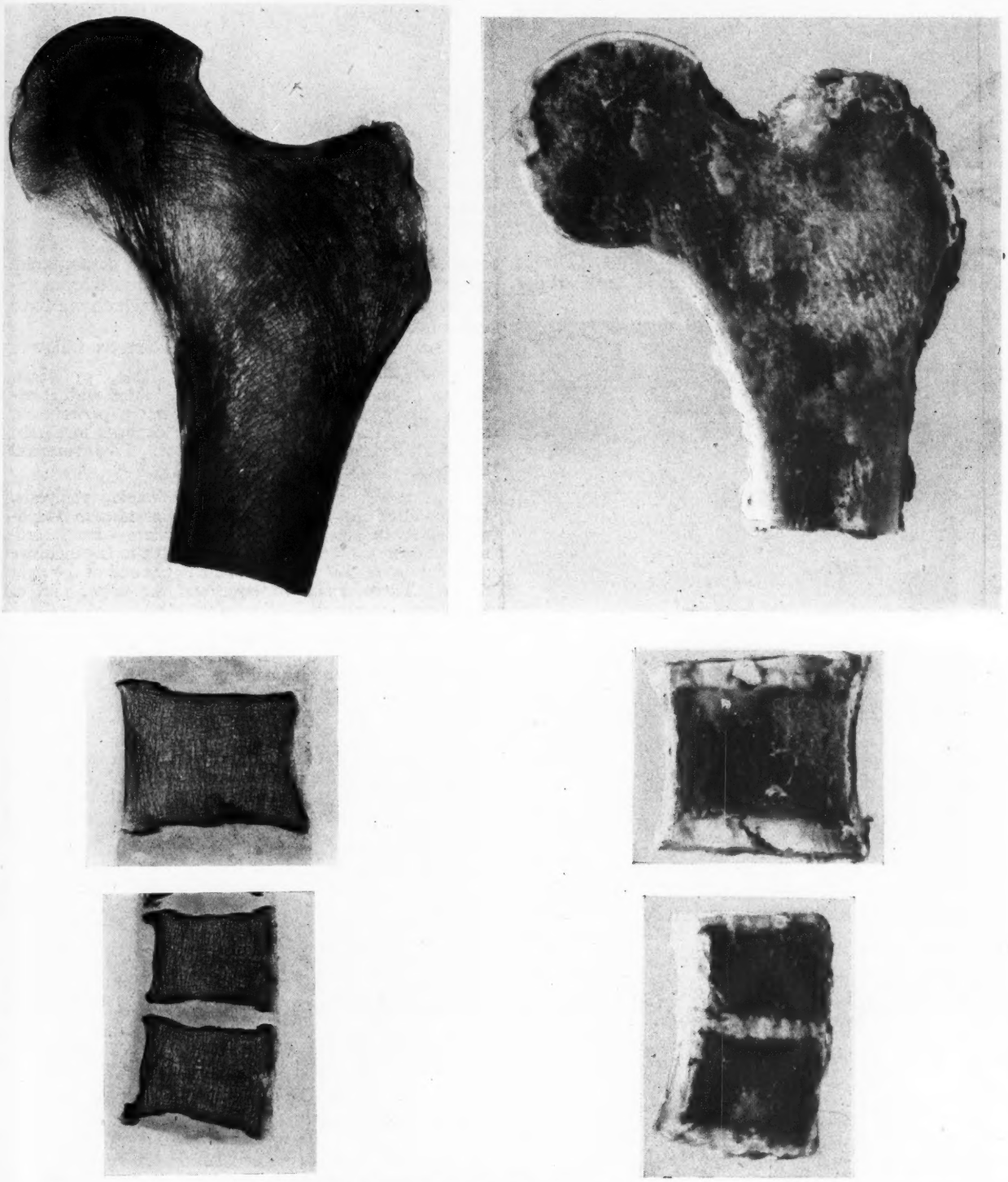


FIG. 427.—*Case* 2. The right-hand column shows the upper part of the femur and three dorsal vertebræ with obvious metastases in the former and two of the latter. The left-hand column shows the normal radiographs obtained from these. (The yellow colour of the tumour in the femur is the result of necrosis.)

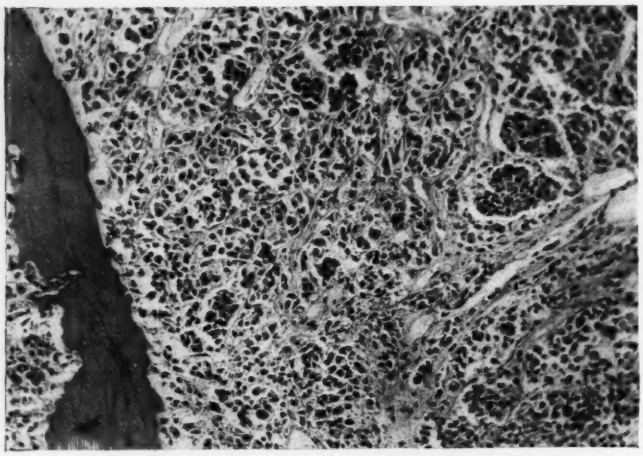


FIG. 428.—*Case* 1. Microphotograph of one of the vertebræ shown in *Fig.* 426. The marrow is replaced by tumour.

FIG. 429.—*Case* 2. Microphotograph of the head of the femur shown in *Fig.* 427. Tumour has replaced the marrow in the upper half.

deposits without apparent bony change. Direct contact radiographs have been made from these excised bones and we have been able to demonstrate macroscopically visible, radiologically invisible, metastases in more than half of the cases which we have examined.

The particular cases illustrated are as follows:

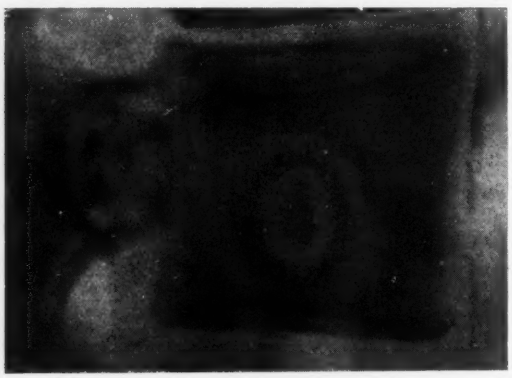
Case 1.—P. M. 3984. H. E., male, 57 years. Malignant melanoma of skin of back. Died with metastases in lymph-glands, liver, lungs, heart, peritoneum, and bone. There were macroscopic deposits in all the vertebral bodies and in several ribs. Five vertebral bodies are shown. (*Figs.* 426, 428.)

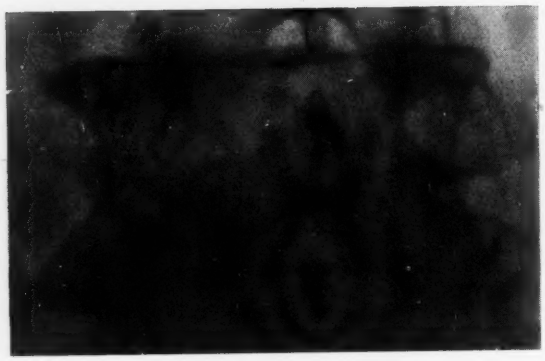
Case 2.—P. M. 4028. A. S., female, 71 years. Carcinoma of bronchus. Died with metastases in lymph-glands, heart, spleen, and bones. There were macroscopic deposits in every vertebra from D.2 to L.5 inclusive and there were also deposits in the upper end of the right femur. Three dorsal vertebræ and the upper part of the femur are shown. (*Figs.* 427, 429.)

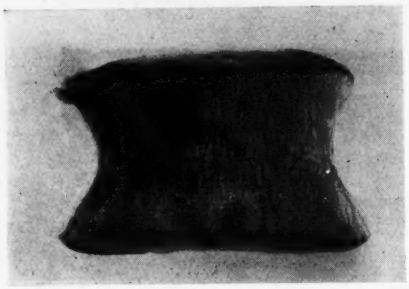
Case 3.—Coroner's P. M. F. D., female, 63 years. Carcinoma of cervix uteri. Died following cordotomy for relief of pain from spinal metastases. The only other metastases were in lymph-glands. The fourth lumbar vertebra is shown. (*Figs.* 430, 432.)

Case 4.—P. M. 4090. R. G., female, 71 years. Hypernephroma of left kidney. Died with metastases in lungs, liver, lymph-glands, right suprarenal, and spine (D.8, D.10, L.1, and L.3.) The first three lumbar vertebræ are shown. (*Figs.* 431, 433.)

These selected cases all show obvious naked-eye metastases but the contact radiographs of the excised







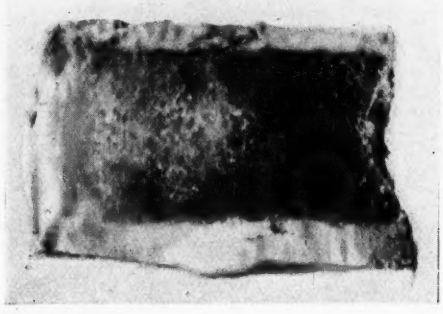


FIG. 430.—*Case* 3. Fourth lumbar vertebra. The upper two radiographs were taken a few days before death and appear normal. The lowest one was taken from the vertebra on the right and shows a little increased density in the region of the tumour.

bones appear to be normal except in *Case* 3, where the clinical radiographs of the fourth lumbar vertebra are shown in the plate and are apparently normal, whereas the contact film reveals an area of increased density. It seems reasonable to conclude that radiographs taken during life, at a greater distance and through superimposed soft tissues, would be less likely to reveal secondary deposits and, in view of the above findings, we would re-iterate that so-called normal radiographs cannot exclude the presence of even extensive bony metastases.

It is a pleasure to acknowledge the help given to us by Dr. J. Duncan White, Director of the X-ray department; E. V. Wilmot, A.R.P.S., photographer; and Miss H. Wilson, school artist.

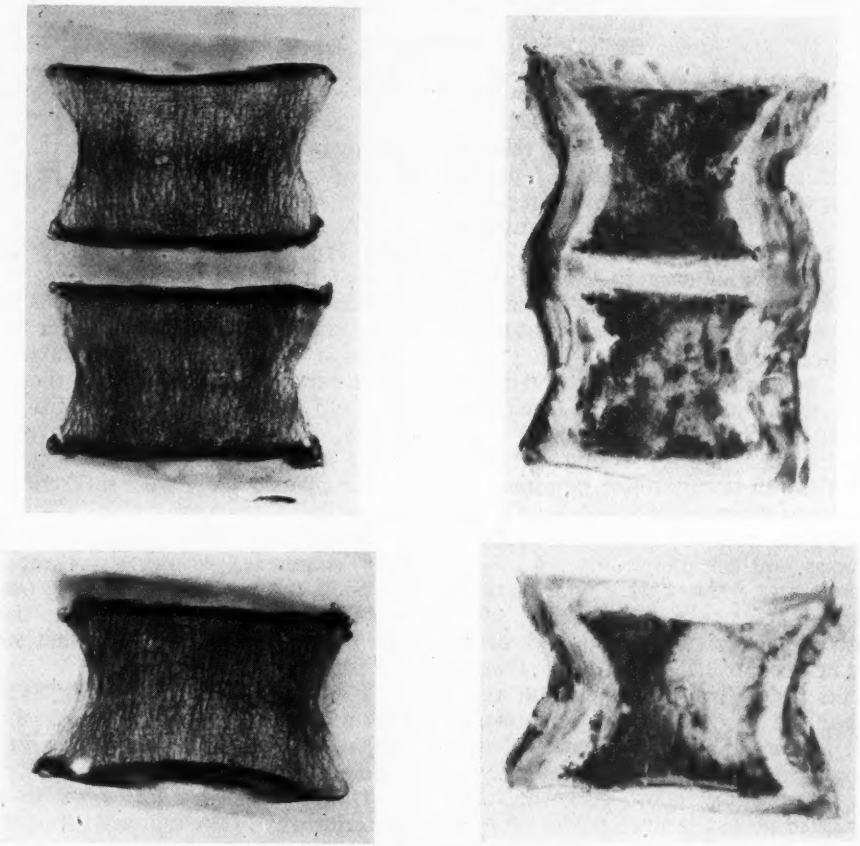


FIG. 431.—*Case* 4. The first three lumbar vertebræ are shown in the right-hand column: there are obvious metastases in two. The normal radiographs of these bones are shown in the left-hand column.

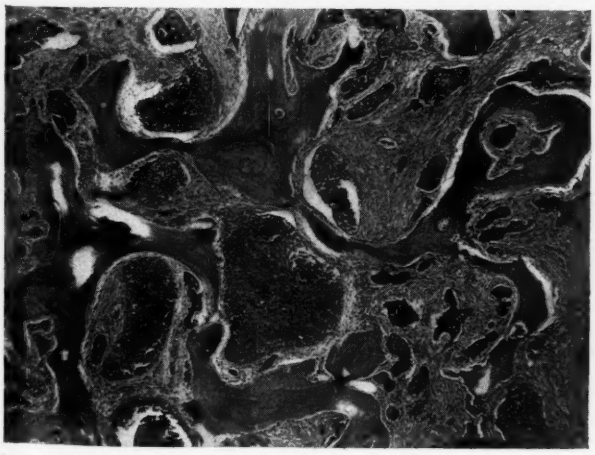


FIG. 432.—*Case* 3. Microphotograph of vertebra shown in *Fig.* 430. The marrow is replaced by tumour which has excited a fibrous stromal reaction. The bony trabeculæ are unaltered.

FIG. 433.—*Case* 4. Microphotograph of one of the vertebræ shown in *Fig.* 431. The marrow is replaced by tumour, but the bony trabeculæ are unaltered.

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WHOLE SKIN-GRAFT REPAIR OF INGUINAL HERNIA

AN ACCOUNT OF 163 OPERATIONS, WITH A FOLLOW-UP OF 136 OPERATIONS AT 12 MONTHS

By C. M. MARSDEN, Brigadier

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When demobilization commenced, the early releases consisted of the older men, many of whom reported sick and were eager to have their disabilities repaired before returning to the hurly-burly of earning a livelihood in civil life.

One of these disabilities was inguinal hernia, either simple or recurrent. The type of patient, whose average age was over 35, was different from that usually seen at military hospital centres. They were of poor physique, pot-bellied with poor abdominal muscles, sagging fascial planes, and more often than not burdened with the chronic dry cough of over-smoking. Their herniæ, usually of long duration, always presented a gap in the posterior inguinal wall or a wide internal ring often made worse by a truss. These herniæ were in need of a major repair or, alternatively, a truss and no operation.

Operation or Truss.—They were poor material for operation and a successful surgical repair often seemed improbable, particularly in the old direct hernia which had been controlled by a truss. During the war we would have considered many of these patients unsuitable for operative repair and instead fitted them with a truss. But these patients were anxious for an operation which had a possibility of cure, especially as the operation and the convalescence occurred during the final weeks of their military service and did not interrupt their earning capacity as civilians. No patient was fitted with a truss or was refused operation.

Efficiency of Current Methods.—We had no experience with silk or floss silk repair and we had to estimate the possibilities of cure with fascial suture repair. We considered that an insufficient amount of fascial suture material would be available in the McArthur type of repair and therefore we started to repair these herniæ with Gallie's fascial strips.

Disadvantages of Gallie Fascial Repair.—

a. We found in this type of repair how useless the thin atrophic conjoined tendon was, and that the arching transversalis and internal oblique muscles were represented as a thin friable sheet. We saw how much trauma the thick Gallie needle inflicted on these structures during the darning and often the gap to be repaired was so large that, in spite of careful darning, small spaces appeared between the strands of fascia lata—perhaps the site for a further recurrence.

b. A Gallie repair involves an operation on the thigh and in service personnel this has been during the war a frequent cause of disability, which has been expressed by the Regimental Medical Officer either as a painful scar or a bulging muscle mass in the thigh when he refers the patient for a specialist opinion. Whether this bulging muscle mass or the long scar, when a stripper is not used, is in fact a real disability is debatable. But it is an objective sign that the soldier can produce to the R.M.O., and the specialist, when he claims that he has a disability in the thigh.

The Skin-graft Repair of Mair.—At this time Mair (1945) claimed that whole thickness of skin sutured under tension, according to his technique, produced such a source of fibrous tissue as to form a continuous thick fibrous sheet extending in one direction distally from the pubic symphysis and pubic tubercle to well above the internal inguinal ring, and in the other direction from the deep surface of Poupart's ligament to well over the aponeurosis of the internal oblique.

He claimed there were no complications of infection or inclusion cysts.

Because the type of hernia described offered a poor chance of a successful repair by standard methods, the District Consulting Surgeon, Brigadier R. Marnham, gave permission to use this technique and transferred to us from other hospitals most of the patients in this series.

The Indications for using Skin-graft Repair after repairing the fascia transversalis, if found, were similar to those for using strips of fascia lata in a Gallie type of repair :—

1. Support must be given to the gap in the posterior wall of the inguinal canal, that gap resulting from the weak atrophic conjoined tendon, and internal oblique and transversalis muscles.

Or 2. In a large oblique hernia of long duration which has produced stretching of the canal and a wide vulnerable internal ring.

Such conditions were present in this series whether the hernia was simple or recurrent.

Is Skin-graft Repair a Suitable Technique for the Army ?—Although Mair's skin-graft technique was performed on the type of hernia outlined above, and almost entirely in officers and men about to be demobilized, it was hoped that this method might be found to be of use in similar cases of hernia in serving service personnel and so avoid interfering with the soldier's thigh. The 163 operations performed in a short period gave an opportunity to evaluate it from that viewpoint.

SCOPE OF THE INQUIRY

Incidence.—Between Aug. 1, 1945, and May 31, 1946, 2482 patients were admitted to the surgical division of this hospital, of which 408 (16 per cent) were operated upon for hernia. Of these, 152 patients were repaired by the skin-graft technique (37 per cent), 11 of which had bilateral hernia. Therefore 163 hernial operations were skin-graft repairs. Of these, 120 (74 per cent) were known to have sheltered during their service in Category 'B' because of their hernia, either because operation had been refused by the patient or by a surgeon who

considered them unsuitable and had, instead, fitted them with a truss.

Type of Hernia.—*Tables I* and *II* show the number of oblique or direct herniæ, simple and recurrent.

Table I.—Types of Hernia Submitted to Skin-graft Repair

	Type of Sac		
	Oblique Down to Scrotum	*Direct*	*Saddlebag*
Total 163	79	77	7

Table II.—Types of Hernia Submitted to Skin-graft Repair

	Type of Hernia			
	Recurrent		*Simple*	
Total 163	86	(*a*) 42 direct (*b*) 43 oblique (*c*) 1 saddlebag	77	(*a*) 35 direct (*b*) 36 oblique (*c*) 6 saddlebag

Notes :—
1. 3 direct sacs were herniæ *en glissade*.
2. 1 direct sac in a recurrent hernia was complicated by a femoral hernia on the same side.
3. 14 oblique herniæ had a direct bulge of the posterior inguinal wall, but not of sufficient size to be called a saddlebag hernia.

Table. III—Duration of Simple and Recurrent Hernia

Type	Average	Longest
	Years	Years
Simple :—		
Direct	3½	16
Oblique	2	9
Recurrent	6	20

Table III shows the duration of the simple and recurrent herniæ.

Tables IV—VI show some details of 68 of the recurrent herniæ out of 86 that were operated upon.

PROCEDURE

1. Anæsthetic.—

Pentothal plus inhalation	141
Inhalation	9
Spinal	9

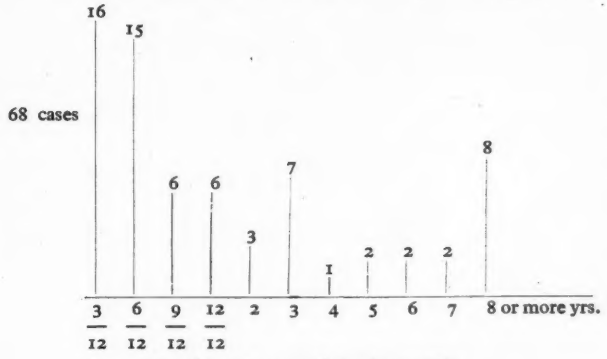
The total number of anæsthetics given is 159; while 163 operations were performed, 4 bilateral hernia had both sides repaired at the same session.

2. Pre-operative Treatment.—In the earlier cases the details as described by Mair (1945) were followed, but later only a routine skin preparation as for any laparotomy was used, commencing the evening before operation. The antiseptic used was iodine.

3. Operation.—

a. The Sac.—In the oblique hernia the sac was excised up to the neck. In the saddlebag type of oblique with direct sacs the epigastric vessels were divided, the now continuous large sac removed, and the cut edges repaired as in a laparotomy. In the 77 direct herniæ the sac was excised in 62 and the cut edges repaired as in a laparotomy, but in 15 the sac was not excised.

Table IV.—Time of Onset of Recurrence after First Operation as noticed by Patient



I.e., 45·5 per cent recurred in six months.
63·2 per cent recurred in twelve months.

Table V.—Recurrent Herniæ: Duration in Years

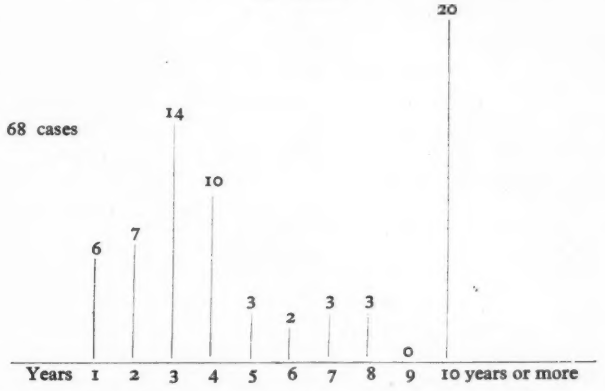


Table VI.—Evidence of Previous Repair found at Operation and Site of Recurrence in 68 Cases

			Direct Sac	*Indirect Sac*
Bassini		26	17	9
Bloodgood		2	2	—
Gallie fascial repair		2	2	—
Repair present, but type not identified	12	38	16	22
No repair, but cord subcutaneous	5			
No repair identified	21			

The 3 cases of sliding herniæ encountered were dealt with by orthodox methods.

Among the 63 cases of direct herniæ a small oblique sac not diagnosed clinically was found in addition in 3 patients.

b. The Fascia Transversalis.—A special point was made to find this structure. We did not find it with certainty. What we thought might be the fascia transversalis was repaired in the direct herniæ by plication and in the oblique by mattress sutures about the cord so as to narrow the opening at the internal ring.

c. The Skin-graft Technique.—This was altered as follows: After the graft had been anchored proximally and distally, the two limbs of the graft were sutured above the cord to give a snug fit to the cord and to leave enough skin-graft above the internal ring. Then the lateral and medial borders of the graft were anchored. There was no sign of interference with the venous return in the cord, even though the appearances on completion of the repair suggested some degree of mechanical obstruction.

In recurrent hernia where there is much oozing, and to prevent formation of a hæmatoma, a separate stab drain was made leading deep to the external oblique for 24 hours. In our earlier cases which we did not drain we had several hæmatomata, but not one became infected in the presence of buried skin.

d. Suture Material.—Double thread No. 60 was used to suture the graft instead of chromic catgut.

e. The External Oblique Flaps.—These were closed over or under the cord, whichever was convenient. The cord was left subcutaneous in 7 cases only, all of which were for operation on recurrent herniæ.

4. Post-operative Routine.—Three weeks strict bed. Immediate post-operative breathing exercises. On the twelfth day abdominal exercises were commenced. These were carried out on the class system by a P.T. instructor or masseuse four times a day. Patients were taught pre-operatively, and progressively the exercises were increased in range and frequency.

On the twenty-first day the patient became weight-bearing, but was not up all day until the twenty-eighth day. Meantime the abdominal routine was continued and early graduated P.T. commenced, which was continued at the convalescent depot where he was retained for a further six weeks.

COMPLICATIONS

There were 123 patients (75 per cent) in whom fever presented, commencing 2–3 days after operation. Of these febrile patients :—

a. Respiratory.—39 were due to respiratory complications such as basal collapse or an acute exacerbation of a chronic bronchitis. They all recovered with symptomatic treatment.

b. Hæmatoma.—15 were due to hæmatoma in the wound. These were all present in recurrent herniæ. None became infected.

c. Infection.—10 were due to infection. This infection was always trivial. It was either a very limited superficial infection anterior to the aponeurosis of the external oblique and not necessarily over the graft or an infection of the incision skin suture puncture holes. All rapidly subsided with or without removal of a suture, with one exception. This man had more severe infection of the subcutaneous areolar tissue over the graft, which resulted in a sinus persisting for 21 days. This healed, to leave a firm wound. He was seen 42 days after operation—the repair was firm. The follow-up twelve months later shows the repair still to be firm. No graft sloughed.

This minor infection occasionally recurred in other hernia operations and also in other clean operations until March, 1946, when this hospital moved to another site and was completely re-equipped. Since that date up to November, 1946, there has been no infection of any clean operation case.

d. No Cause Found.—51 out of 163 of the skin-graft repairs (31 per cent) had a febrile reaction without physical signs. The patients felt well, had good appetites, no complaints, a pulse-rate less than 80, and a normal total white and differential count. The fever lasted 7–10 days, usually to 100° F. at night, and subsided by lysis, while in the other hernial operations the fever lasted three or four days only.

One patient had a symptomless temperature for 21 days. He was completely investigated and no cause found. After being afebrile for seven days he was transferred to a convalescent home. His repair is firm at the end of 12 months.

In the first 20 operations we were apprehensive of this febrile reaction and used parenteral penicillin, but soon evaluated it (and also the minor infection that occasionally occurred) for what it was worth and ignored it.

In the early operations of this series we compared this febrile post-operative period with other hernial cases operated on during the same period. *See Table VII.*

Table VII.—PYREXIA AFTER HERNIA OPERATIONS

	44 *Skin-graft Repair*	39 *Other Hernial Operations*
Apyrexial	12 (27·2 per cent)	20 (51·2 per cent)
Pyrexial	32 (72·8 per cent)	19 (48·8 per cent)
a. Due to pulmonary complications	8	10
b. Wound infection	3	1
c. No cause found	21	8

e. Incision.—This, during the first week, does not look nice but is not actually inflamed and has the appearance that one would associate with a little rise in temperature. Later we noted that those who had a febrile reaction had a marked but not painful thickening beneath the healing or healed incision over the buried skin.

f. Sinus Formation.—In 5 operations performed after this series, we have had 5 persistent sinuses. They were all explored after the sinus had persisted for one to two months and they presented similar appearances. The graft was healthy and firmly attached at all its points of fixation. Each thread suture was loose and surrounded by a minute pool of pus. After removing all the loose thread, the external oblique and skin were closed and the wound healed firmly. Mair (1946) reports a similar sinus with thread suture material and similar appearances at operation. He uses chromic catgut.

Comment : The buried skin-graft is infected material, but the tissues appear to be able to overcome this ; in doing so there is general reaction with fever, whilst locally the incision does not look quite nice and later there is a general thickening beneath the scar.

The skin-graft must be sutured under considerable tension and we thought thread, an unabsorbable material, to be the best for this. It appears that occasionally the tissues cannot overcome both the buried skin-graft and unabsorbable suture material.

g. There were no other complications.

RESULTS

These patients were now demobilized. They were no longer subject to military discipline and any examination could only be achieved by co-operation on the patients' part. They had diffused all over Britain and even in an organization like the army a full follow-up was bound to be difficult.

It was decided to have them examined, preferably by a surgeon, at six months to note any recurrence or any other disability and to follow them up at 12 months by means of a *pro forma*. This *pro forma* asked the patient if he thought he had any sign of a

recurrence to have himself examined by a surgeon or his own doctor.

At six months 144 patients, 10 with bilateral hernia, i.e., 154 operations out of a total of 163, were examined (54 per cent by surgeons, 46 per cent by doctors). There were 8 recurrences (5 per cent).

At 12 months 126 patients, 10 with bilateral hernia, i.e., 136 operations, replied (44 per cent were examined by a surgeon or a doctor) and the recurrences had increased to 16 (9·8 per cent).

These replies are analysed in *Table VIII*.

Table VIII.—Analysis of the 136 Replies and the Recurrences at Twelve Months

	Operations Performed	*Recurrences*
Direct Hernia :—		
Simple	36	3 (8·3 per cent)
Recurrent	38	9 (23·7 per cent)
Total	74	12 (16·2 per cent)
Oblique Hernia :—		
Simple	27	1 (4·0 per cent)
Recurrent	35	3 (8·6 per cent)
Total	62	4 (6·45 per cent)

NOTES ON THE RECURRENCES AT THE 12 MONTHS FOLLOW-UP

A. Direct Hernia (Total 12).—

1. Six recurred at six months.

2. Nine were for operations on recurrent direct hernia.

3. One was for hernia *en glissade* (simple hernia).

4. One hernia was of saddlebag type in a recurrent hernia. Five other saddlebag herniæ were sound at 12 months.

5. Of the 12 recurrences 9 did not have the sac excised. (There were 15 operations in this series of direct hernia in which the sac was not excised).

6. The percentage of recurrences is 16·2 per cent—12 out of 74 replies (36 simple, 38 recurrent direct hernia).

7. If the 15 operations in which the sac was not excised are omitted, the recurrence rate for direct hernia falls to 6·8 per cent (4 in 59 operations).

B. Oblique Hernia (Total 4).—

1. Two recurred at six months.

2. Three were for operations on recurrent hernia.

3. One sac was oblique with also a bulge of the posterior inguinal wall.

4. One oblique sac was complicated by a femoral hernia on the same side. This was in recurrent inguinal hernia.

5. The percentage recurrence is 6·45 per cent—4 out of 62 replies (27 simple and 35 recurrent oblique hernia).

C. Bilateral Hernia.—Eleven patients were operated on; there were 10 replies and no recurrences.

RECURRENCES IN DETAIL

A. Those recurring in Oblique Hernia.—

No. 1419.—Aged 26. Diagnosis Rec. R.I.H. oblique. Original operation Bassini, 1941, which recurred six months later. Excision of sac and skin-graft repair Dec. 3, 1945. Afebrile convalescence. Recurred at six months. Site "lower part of canal and external ring".

No. 559.—Aged 30. Diagnosis Rec. R.I.H. oblique with direct bulge of posterior wall of inguinal canal. Original operation, 1944. Type of repair unknown. Recurred March, 1945. Excision of sac and skin-graft repair November, 1945. Post-operatively had temperature for nine days. On eighth day hæmatoma of incision evacuated. Incision healed and wound satisfactory on discharge. Recurred six months later. "Direct bulge at internal ring."

No. 327.—Aged 29. Diagnosis L.I.H. oblique. Duration five years. Large thick-walled sac with wide mouth with adherent omentum. Excision of sac and skin-graft repair August, 1945; uneventful convalescence. Recurred at twelve months. "Ventral hernia at site of scar."

No. 837.—Aged 39. Diagnosis Rec. L.I.H. indirect, with weakness of posterior wall of inguinal canal and simple femoral hernia L. Original operation July, 1940, Bassini. Recurrence six months later. Excision of sac and skin-graft repair. Excision of femoral sac (no repair) Oct. 4, 1945. Febrile with minor infection of the incision for eight days. Recurred six months later. "Slight bulge at internal ring."

B. Those recurring in Direct Hernia.—

No. 197.—Aged 36. Diagnosis R.I.H. direct, duration three years. Sac not excised, skin-graft repair January, 1946. Apyrexial convalescence. Patient states recurred at six months—surgeon states "Recurrence at internal ring at 12 months".

No. 1299.—Aged 39. Diagnosis Rec. R.I.H. direct. First operation, 1944, type unknown. Recurred in three months. Second operation, 1944, Gallie repair. Recurred in six months. Sac not excised and skin-graft repair November, 1945, with uneventful convalescence. Recurred six months later. "As a direct bulge containing bowel and easily reducible ? hernia *en glissade*."

No. 265.—Aged 35. Diagnosis Rec. I.H. direct. Original operation May, 1942, recurred within six months. Sac not excised, skin-graft repair January, 1946. Superficial infection of incision. Healed rapidly—firm on discharge. "Direct recurrence" within six months. Said to be irreparable by surgeon. Now wearing truss.

No. 283.—Aged 32. Diagnosis Rec. I.H. direct. Original operation, 1943, Bassini. Recurred, 1944. February, 1946, sac not excised and skin-graft repair with afebrile convalescence. "Recurrence at four months at the internal ring."

No. 410.—Aged 28. Diagnosis Rec. L.I.H. direct. Original operation, 1944, type unknown; recurred within a few months. Sac not excised, skin-graft repair February, 1946. Afebrile convalescence. Recurred at six months as "a direct bulge, and is wearing a truss".

No. 452.—Aged 32. Diagnosis Rec. I.H. direct. Original operation, 1938. Repair unknown. Recurred, 1945. Sac not excised and skin-graft repair February, 1946. Afebrile convalescence. Recurred at 12 months as a "general bulge of the posterior wall without a true sac".

No. 503.—Aged 33. Diagnosis Rec. R.I.H. direct. Original operation, 1942, type unknown. Recurred three months later. Sac not excised and skin-graft repair March, 1946. Afebrile convalescence. Recurred 12 months later as "direct bulge at internal ring".

No. 600.—Aged 26. Diagnosis Rec. R.I.H. direct, Original operation, 1937, type unknown. Recurred, 1942. Sac not excised and skin-graft repair April, 1946. Afebrile convalescence. Recurrence at 12 months "at the posterior wall of the canal".

No. 301.—Aged 40. Diagnosis Rec. L.I.H. direct. Original operation, 1944. Recurred in a few months. Sac not excised and skin-graft repair in February, 1946. Afebrile convalescence. Firm at 12 months but "recurred as direct hernia at 14 months and is wearing a truss".

No. 359.—Aged 40. Diagnosis Rec. R.I.H. oblique and direct. Hernia commenced in 1943. Controlled with a truss. Operated on, 1945. Immediately recurred.

Large thick-walled saddleback sac excised and skin-graft repair, February, 1946. Afebrile. Recurred at 12 months as a " weakness of posterior walls on both sides and a tendency to recurrence ".

No. 1296.—Aged 38. Diagnosis R.I.H. direct. Duration 18 years, controlled with a truss. Original hernia was an oblique down to scrotum; now there is direct hernia *en glissade*. November, 1945, large thick-walled sac excised and sliding hernial sac repaired. Skin-graft repair. Afebrile. Recurred five months later as a medium-size bulge down to neck of scrotum. " Almost certainly an indirect sac."

No. 796.—Aged 43. Diagnosis R.I.H. direct. May, 1946, sac excised and skin-graft repair. Afebrile. Recurred as " small bulge at external ring " in three months.

SUMMARY

A total of 163 inguinal herniæ were repaired by the skin-graft technique of Mair (1945). During the period when these operations were carried out no patient was refused operation and fitted with a truss.

Of these, 136 operations (63 simple and 73 recurrent) were followed up at 12 months and 9·8 per cent recurred; 16·6 per cent of the recurrent hernia showed a further recurrence.

Table VIII analyses the recurrence rates of the simple and recurrent hernia and of the direct and oblique herniæ.

In 15 operations on direct hernia the sac was not removed. Of these 9 recurred (60 per cent), 8 in recurrent hernia, 1 in simple hernia. If these 15 operations are omitted the percentage of recurrences in direct hernia falls from 16·2 (12 in 74 operations) to 6·8 (4 in 59 operations).

Table IX compares the recurrence rate of Gallie fascial repair, Mair's (1946) recurrence rate for skin-graft repair, and the recurrence rate in this series in direct hernia.

Table IX.—Comparison of Recurrence Rates of Gallie Fascial Repair with Skin-graft Repair for Direct Hernia

Surgeon	Operation	Number	Percentage Recurrence
Cattell-Anderson, McLoskey (1940)	Gallie	—	11·7
Mair (1946)	Gallie	27	29·0
Mair (1946)	Skin-graft	27	0
This series (total)	Skin-graft	74	16·2
This series, if the 15 operations in which the sac was not removed, are omitted	Skin-graft	59	6·8

Table X.—Comparison of Recurrence Rates of Gallie Fascial Repair with Skin-graft Repair for Oblique Hernia

Surgeon	Operation	Number	Percentage Recurrence
Foster (1936)	Gallie	101	7·0
Gould (1940)	Gallie	87	9·2
Page (1943)	Gallie	39	15·4
Mair (1926)	Gallie	59	3·3
Mair (1946)	Skin-graft	86	1·1
This series	Skin-graft	62	6·45

Table X gives a similar comparison in oblique inguinal hernia.

CONCLUSIONS

1. Provided that thread was not used as suture material, the trivial wound infection that occasionally occurred could not be traced to the buried skin.

2. Inclusion cyst formation was not reported at 12 months. It is proposed to follow up this question at three years.

3. The only complication reported was a swelling beneath the scar which a surgeon observed for six months. It is subsiding; but the surgeon suspects a collection of sebaceous material. He states the repair is firm and remains under his observation. This patient had a right recurrent direct hernia. The original Bassini repair was performed in 1941. Within a few months it recurred. A direct sac was excised and a skin-graft repair was performed in December, 1945. This is the patient who had a more severe areolar infection and a sinus which persisted for 21 days.

4. Considering the type of hernia we repaired, the recurrence rates, though high, are not excessive.

5. In this series there was a high percentage of recurrence when the sac of a direct hernia was not excised.

6. The recurrence rates are higher than those reported by Mair (1946), but are similar to those of a Gallie repair.

7. In this series the indications for using a skin-graft repair were similar to the indications for using strips of fascia lata. The recurrence rates for both types of repairs are similar but the skin-graft repair avoids an operation on the thigh which may give a long scar or a muscle hernia, which, as Edwards (1943) points out, is a disadvantage in the soldier but which disadvantage might not apply in equal force to civil surgery.

8. It is proposed to follow up these patients in two years. Until this operation is proved to be of value and to have no remote morbidity, it should not be used, yet, on the serving soldier (Consulting Surgeon to the Army, 1947).

I wish to thank Brigadier R. Marnham, Consulting Surgeon, for his interest in the problem of inguinal hernia of the soldier about to be demobilized and for his permission to use this form of repair, and to thank the Consulting Surgeon to the Army, Brigadier D. Fettes, O.B.E., who in February, 1946, gave permission to continue to use it in selected patients about to return to civil life who had had repeated recurrences, and in whom the prospects of cure by ordinary methods seemed unpromising.

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INDIRECT INGUINOFEMORAL HERNIA

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THE vast majority of herniations of the abdominal cavity can be classified satisfactorily into one or other of the main clinical types according to their site of appearance, reducibility, contents, and the presence or absence of intestinal obstruction. Of the rare and anomalous hernias described, many differ from those which are met with in general surgical practice only in that the contents of the hernial sac are unusual. In the case described below, the actual sac and its contents call for little comment, whilst the course taken by the sac is so abnormal that a search of the literature has revealed no similar published case. The neck of the sac was found in the region of the internal inguinal ring, lying lateral to the inferior epigastric artery. Proceeding down the inguinal canal, the sac passed through a deficiency in the medial part of the inguinal ligament. The further course of the hernia via the fossa ovalis and the position of the fundus of the sac, which was located superficially to the femoral artery just below the inguinal ligament, accounted for the pre-operative diagnosis of femoral hernia. Unobskey (1941) has recorded one case of a biloculated indirect inguinal hernia in which one loculus presented at the external inguinal ring and the other perforated the inguinal ligament.

Ogilvie (1937) described an uncommon type of inguinal hernia which possessed certain characteristics of both direct and indirect inguinal herniations and it is well recognized that besides the 'pantaloon' or 'straddling' type of hernia described by Hoguet (1920) and Eliot (1925) both indirect and direct inguinal hernias may occur on the same side at the same time in the same patient (Stiven, 1922; Hartridge, 1926; Skinner and Duncan, 1945).

Homolateral inguinal and femoral hernias may coexist (Cole, 1924; Junkin, 1933; McClarin, 1938) and the appearance of a femoral herniation is occasionally noted shortly after the repair of an inguinal herniation of the same side (Easton, 1933; Shafranskiy, 1940). Fauntleroy (1920) described a case in which the spermatic cord and an empty diverticulum of peritoneum passed through the femoral canal. The inguinal canal was found to be empty and the testicle was found normally placed in the scrotum.

Evidently from clinical considerations alone, there is a close association between the pathways traversed by inguinal and femoral hernias and an anatomical study of the medial part of the inguinal ligament confirms this thesis.

Of all abdominal hernias, 79 per cent, consisting of right and left direct and indirect inguinal and femoral hernias, make their exit from the peritoneal cavity in the medial and lower part of the anterior abdominal wall, where an oval weak area can be defined bilaterally. It is bounded below by Cooper's ligament (i.e., the thickened part of the pectineal fascia), externally by Hey's ligament (sometimes called the iliopectineal ligament), above by the free border of the internal oblique muscle, and internally by the arched border of the conjoined tendon and the lacunar ligament (Gimbernat's ligament). This ovoid area is divided into an upper and a lower segment by the inguinal ligament (Poupart's ligament). The area described is weaker than any other part of the abdominal wall and its chief retaining membrane is the fascia transversalis which lines the entire abdominal wall and which lies external to the peritoneum. The fascia transversalis is normally thicker here than elsewhere (McQueeny, 1926).

In the upper segment of this ovoid area of weakness described is the inguinal canal, which passes medially and downwards in the direction of the

FIG. 434.—The inguinofemoral area of weakness.

inguinal ligament which forms its floor. The lower segment of this ovoid area of weakness, which is sometimes called the lacuna vasorum, contains the femoral sheath. The femoral artery and vein occupy the lateral and middle compartments of the sheath, respectively, whilst the most medial compartment is the femoral canal, the direction of which is that of the femoral vessels, i.e., downwards and laterally. The long axes of the two canals are therefore approximately at right angles to one another and their lumina are separated only by the medial part of the inguinal ligament and by that part of the femoral sheath which invests the femoral canal. Should these structures be perforated, it would be possible for an inguinal hernia to become a 'femoral' hernia or vice versa. (*Fig.* 434.)

At the bedside, direct inguinal hernias may occasionally simulate femoral hernias, and indeed Continental writers have suggested that femoral hernias should be converted into 'inguinal' hernias

in order to effect their repair (Hofman, 1941). It is rare, on the other hand, for indirect inguinal hernias to present in the region of the fossa ovalis as happened in the case detailed below.

CASE REPORT

A deaf and dumb boot repairer, aged 46, was admitted to hospital with some discomfort in the region of the upper and inner quadrant of the right thigh. He had not vomited and had had a bowel action on that same day. No further history could be reliably elicited.

On Examination.—A small, firm, mobile swelling, which was obviously very tender, was discovered in the right femoral region about 2 in. below and lateral to the pubic spine. It was about 1 in. in diameter and was translucent. An expansile cough impulse was present, but an effort to reduce the lump proved fruitless. The patient was a very thin individual and it was apparent that the swelling was closely related to the femoral artery, as transmitted pulsation from that vessel was easily visible.

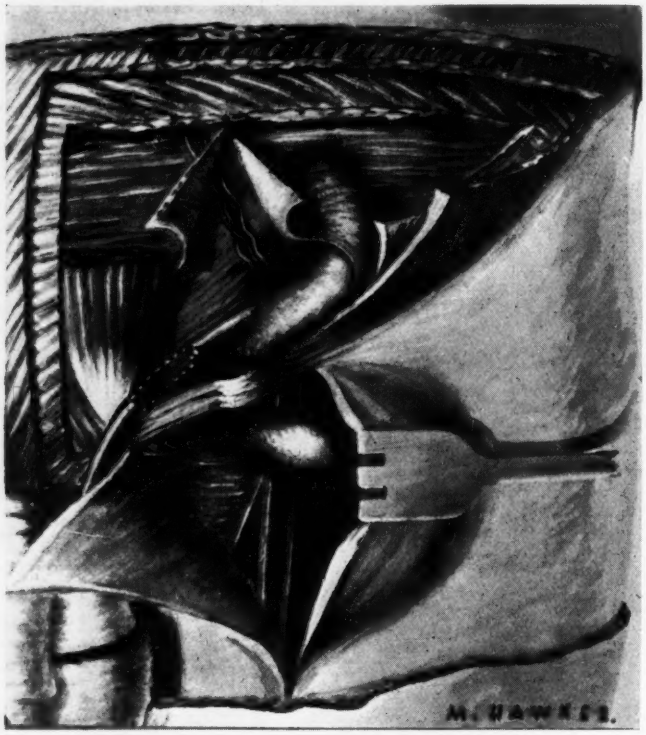

Fig. 435.—Showing an indirect inguinofemoral hernia (semidiagrammatic).

A diagnosis of irreducible femoral hernia was made and an immediate operation was advised.

At Operation.—Spinal anæsthesia was induced and a vertical incision over the swelling was made in order to avoid the possibility of damage to the closely contiguous vessels. A sac of peritoneum was found coming through the fossa ovalis and it was traced upwards to the region of the femoral ring. Here, instead of continuing inwards through the medial compartment of the femoral sheath, the sac was found to pass anteriorly through a small aperture in the medial part of the inguinal ligament about ¼ in. from its lower free border. Positive identification of the medial compartment of the femoral sheath was not possible, as is frequently the case in the operating theatre, and a search for its more proximal portion was considered inadvisable. Evidently the hernial sac had usurped its position. The relation of the sac to the vas deferens, which lay at first medially and then posteriorly, was demonstrated, and its origin in the region of the internal inguinal ring, lying on the lateral side of the inferior epigastric artery, was determined (*Fig.* 435).

The constricting structure was found to be the hiatus in the inguinal ligament, and, on enlarging this deficiency and opening the peritoneal sac, reduction of viable small gut was easily accomplished. The sac of peritoneum was isolated and its neck tied as closely as possible to its site of origin and the body and fundus were then excised. Two interrupted catgut sutures were used to repair the deficient part of the inguinal ligament and the wound was closed with interrupted silkworm gut sutures.

Progress.—The patient made an uneventful recovery, and when last seen, one year after operation, the wound was found to be soundly healed and no recurrence of the hernia could be detected.

SUMMARY

Certain rare herniations are reviewed and some difficulties in exact pre-operative diagnosis discussed.

The anatomy of the weak oval area of the anterior abdominal wall through which inguinal and femoral herniations pass is described and the close association between the inguinal and femoral canals emphasized.

A unique case of hernia is recorded for which the name indirect inguinofemoral hernia is suggested. Attention is drawn to the success of a comparatively simple repair operation.

It is a pleasure to thank Miss Mary Hawker for the illustration and diagram and Mr. S. Hogwood for their photographic reproduction.

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TRAUMA OF THE HAND

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1. REPAIR OF FLEXOR TENDONS OF THE HAND

THIS paper presents a series of 42 consecutive cases in which flexor tendons were divided within their sheaths. In it an attempt is made to give the reasons for the decisions taken in repairing these injuries. As the series progressed, so did our experience, and techniques adopted in early cases were replaced by more satisfactory methods of treatment. Thus it became apparent from results that primary repair, if chosen wisely with good operative technique and carefully supervised after-care, holds out infinitely better prospects of functional recovery than any delayed procedure. Again, if repair of a divided tendon is long delayed—six months or more—the muscle belly of that tendon may have undergone such changes that repair by graft may offer little prospect for good function. It is wise under these circumstances to accept this fact and to transplant to the damaged finger a tendon with a fully functioning muscle belly.

ANATOMY

When considering repair of tendons on the palmar aspect of the fingers and hand the approach must be adequate fully to expose the operative field. The incisions through skin and fascia, however, must be very carefully planned if skin and fascial deformities are to be avoided. The lines of incision in this series were all planned to follow the crease lines of the hand and fingers and were extended along the relatively immobile skin in the mid-lateral lines of the hand and fingers. The principle followed is to make skin and fascial incisions along lines where these structures are normally immobile and to avoid all incisions across lines of great soft tissue mobility.

The detailed anatomy of the relations of the flexor tendons in the hand to the tendon-sheaths and fascial spaces is fully described elsewhere and no attempt will be made to cover it here.

Attention is drawn to three points of practical anatomy :—

1. With the fingers in the extended position the sublimis tendon begins to divide to let the profundus through at the middle of the proximal phalanx. When the proximal interphalangeal joint is flexed the division of the sublimis moves up to a more proximal level. If the examining clinician appreciates this fact he will understand that cuts over the proximal finger crease can and do divide the profundus tendons completely and leave the sublimis tendon completely undamaged.

2. Suture of a flexor tendon is ideally undertaken outside the flexor sheath. This 'site of election' lies between the proximal end of the flexor sheath and the origin of the lumbrical muscles on the profundus tendons. This point lies directly below the superficial palmar arch.

3. In three patients we have noted that the sublimis tendon of the little finger was present only as a rudimentary slip. Division of the profundus tendon alone resulted in complete loss of all interphalangeal joint movements.

INDICATIONS FOR TENDON REPAIR

In no case in this series have we encountered division of the sublimis tendon alone ; on theoretical grounds we would consider its primary suture unnecessary and perhaps functionally dangerous. Division of the profundus tendon alone is a common injury. All such injuries are repaired, with the following exceptions :—

1. Where the profundus tendon alone is divided over the proximal phalanx.

2. Where the profundus tendon alone is divided over the base of the middle phalanx.

The results of attempted primary suture at these levels are unsatisfactory. Invariably adhesions form between the repaired profundus and the intact sublimis tendons, with loss of sublimis function, i.e., loss of proximal interphalangeal joint movement present before the repair of the severed profundus tendon. *Cases* 30 and 33 required subsequent division of adhesions to restore a useful range of movement.

As a primary procedure it is wise to confine the repair in these injuries to the covering soft tissues and leave the tendon alone.

Where both profundus and sublimis tendons are severed (the commonest injury) the sublimis tendon is excised from its insertion to a level above the tendon-sheath and the profundus tendon alone is repaired.

Absolute Contra-indications to Primary Repair of Tendons.—

1. Where division of a tendon is associated with loss of covering soft tissues, the primary operation is confined to a skin-grafting procedure.

2. When division of the tendon is associated with gross neurovascular damage the primary procedure is confined to nerve suture, skin repairs, and methods aimed at restoring an adequate circulation, i.e., pressure dressings and controlled cooling.

3. Where the lesion is associated with open joints or bone damage.

4. When soft-tissue wound excision fails to cleanse the wound or when the wound is seen late.

PRIMARY REPAIR OF TENDONS WITHIN THE SHEATH

The real objective in all tendon repairs is to achieve sound union of the tendon without adhesions to the surrounding structures—to end with a soundly united tendon moving freely within its sheath.

To achieve this result two matters require particular attention : First, the accident wound through the covering soft tissues must not be in direct contact with the approximated tendon ends. If this is allowed a solid block of reparative fibrous tissue will unite skin, fascia, sheath, and tendon, so fixing the tendon soundly to its surrounding tissues.

Secondly, the proximal end of the tendon to which is attached the powerful muscle belly must be so controlled that there is a minimal risk of the muscle pulling apart the approximated tendon ends.

In most cases both these objectives can be met by correct positioning of the limb after suture.

It must be accepted that the wound in the skin, fascia, and tendon-sheath are fixed in position. Further, by varying the positions of the interphalangeal joints the approximated tendon ends can be moved either proximally or distally away from the traumatized area. There is usually an amplitude of ½ to 1 in. of movement.

The muscle belly attached to the proximal tendon end can be placed at such a mechanical disadvantage by positioning that the risk of the suture pulling out by a distracting force during the healing phase is obviated.

If these two principles are applied, then primary repair is sound, and when followed in this series gave excellent functional results—our failures are to be found in those patients in which we did not or could not apply them.

For example, our really successful repairs are in tendons which have been divided when the interphalangeal joints have been in the flexed position and suture has been undertaken early. After suture, the suture line is moved distally away from the wound in sheath and skin by extending the interphalangeal joints. The finger is immobilized in this position.

Next the involved muscle belly is put at a mechanical disadvantage by flexing the metacarpophalangeal joint, and, more important still, the wrist-joint. This position is also fixed by a plaster splint. The position is held for five to six weeks. With such rest the repair is effected with the minimum of fibrosis.

However, when fingers are cut in the extended position and the flexor tendons divided, these principles cannot be followed strictly. It is very difficult by joint positioning to relax the muscle belly and at the same time move the suture line of the tendon proximally so that it is well away from the wound. When tendons are cut in extension their repair is undertaken by a free tendon graft (using palmaris longus or sublimis) as a primary procedure. Both sublimis and profundus tendons are excised from the length of the sheath and the free graft is used to replace these divided tendons. Thus we follow the principles which we consider fundamental, i.e., all sutures in tendon away from soft-tissue wounds and the muscle belly at a mechanical disadvantage during the initial healing phase.

During the wound inspection at the primary operation it is a simple matter to be sure of the position the interphalangeal joints occupied when the tendon was divided. The joints are manipulated until the *distal* end of the tendon lies at the level of the cut sheath. This is the position at the time of division.

DELAYED REPAIRS OF DIVIDED TENDONS

It is important in any delayed repair first to wait until the divided tendon has passed through its period of œdema, for during this phase it holds suture material poorly and traumatizes very easily. Next, not to delay so long that the muscle belly has lost its power of full contraction and relaxation.

These criteria fix the optimum period of delay from four to six weeks after the primary injury. Obviously no tendon repair should be carried out in the presence or suspicion of wound infection.

Finally, if repair has been delayed so long that the muscle belly has undergone such changes that a tendon graft of some length is necessary to bridge the gap, it is wiser to transplant a healthy sublimis from a neighbouring finger. If the tendon itself is shortened it is better to insert a free graft in the 'site of election' rather than to suture the tendon with all the joints of the hand flexed. (*Case* 23—5 years after injury—sublimis transplant with free graft of palmaris longus.)

RESULTS

(*Figs.* 436, 437, *Tables I–III*)

This series consists of 42 cases of cut flexor tendons of fingers and thumb. All cases reported are those where the division was inside the synovial lined sheath.

Of these 42 cases, 24 were divisions of both profundus and sublimis, 12 were divisions of profundus alone, and 6 were divisions of the flexor pollicis longus within its sheath.

In the 24 divisions of both tendons the profundus alone was repaired; where possible the repair was by direct suture, but in some grinding injuries the trauma to the tendon was so extensive that the tendon had to be excised as part of the wound toilet and then replaced by a free graft. The disadvantage of the free graft is that at the end-result the finger is invariably handicapped by a fixed flexion deformity, which, according to Bunnell, is due to the death of the central portion of the grafted tendon, with resultant fibrosis and shortening.

Of these 24 cases, 30 per cent gave very nearly a full return of movement of the proximal interphalangeal joint and a useful range of distal interphalangeal joint movement. In 2 cases (*Cases* 6 and 8) the pulleys over the proximal phalanx were lost at the original trauma and were not repaired at primary operation; however, those patients were satisfied with the degree of movement and working function and did not wish to have any further operation. (*Fig.* 436.)

Twenty of the results are classified as 'good'—with sufficient movement to enable the workman to get real working function for the damaged finger, particularly in his ability to grip.

Three cases are classified as 'bad'—with only a small range of interphalangeal joint movement.

In the 12 patients in which the profundus tendon alone was divided, primary suture was undertaken when it was possible to achieve this without encroaching on the proximal phalanx.

In 3 cases (*Cases* 29, 32, and 35) freeing of adhesions was undertaken at a second operation because there was loss of proximal interphalangeal joint movement. When results gave a full or nearly full proximal interphalangeal joint movement with a useful range at the terminal interphalangeal joint the result was accepted and no attempt was made to improve movements by dividing adhesions.

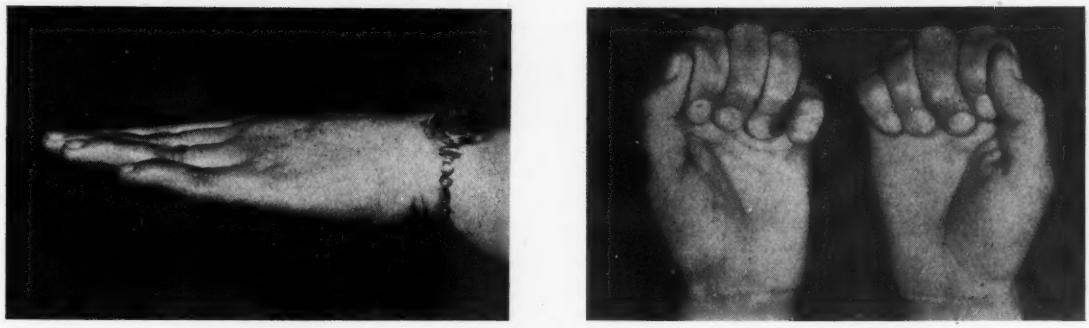
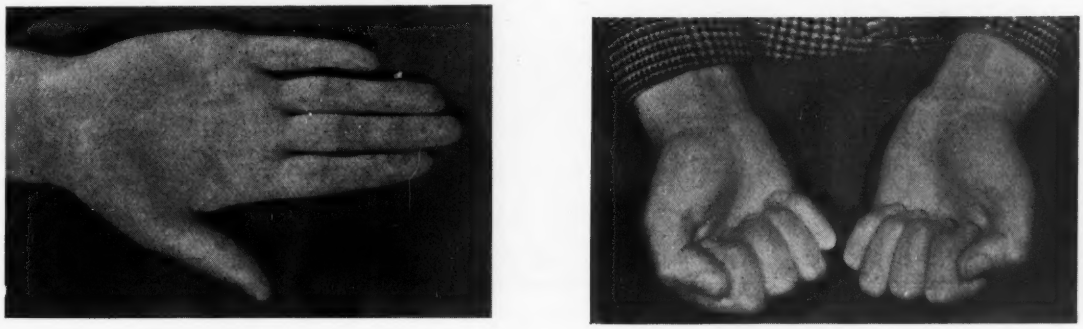
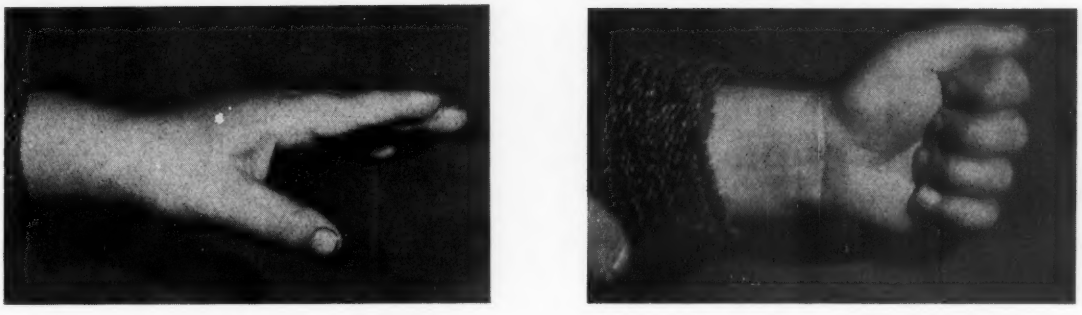


FIG. 436.—*Case* 6. Photographs showing interphalangeal flexion with metacarpophalangeal joints in extension. Note loss of proximal interphalangeal joint flexion associated with loss of 'proximal pulley'.



A B



C D

FIG. 437.—A, B, *Case* 14. Shows range of movement after repair of profundus tendon only in right little finger. Both flexors were divided over the proximal phalanx. C, D, *Case* 24. Similar injury in small child.

Of the 12, 1 case had a very good result; 9 cases were good results; and 2 cases were poor, with very little movement.

There were 6 patients treated who had severed the flexor pollicis longus within its sheath. Of these, 4 were treated by direct suture; in 2 it was considered wise not to undertake immediate suture for both had in addition considerable damage to the posterior wall of the sheath associated with bone damage to the proximal phalanx. Therefore in these two cases the distal portion of the tendon was excised, a lengthening of the tendon at the wrist undertaken, and the whole tendon slid down and sutured at its insertion. This procedure took the suture line away from the damaged posterior wall of the sheath and prevented the possibility of adhesions.

In this series *Case* 37 was a precision tool worker undertaking extremely fine work, in the handling of fine screws and instruments; full flexion of his thumb interphalangeal joint was essential and a secondary adhesion-freeing operation was necessary to restore this movement to its full range with entirely satisfactory results.

In this series of 6 cases 2 cases gave excellent results and 4 cases good results.

Most of the indifferent results in the entire series are in the tendon repairs which have for a variety of reasons been delayed for six weeks to as many months. The permanent deformities have been in flexion, varying from 20° to 40°. In these cases a useful degree of further flexion was possible, for example *Case* 1 had 50° of proximal interphalangeal joint movement but a flexion deformity of 40°, giving him a functional degree of opposition.

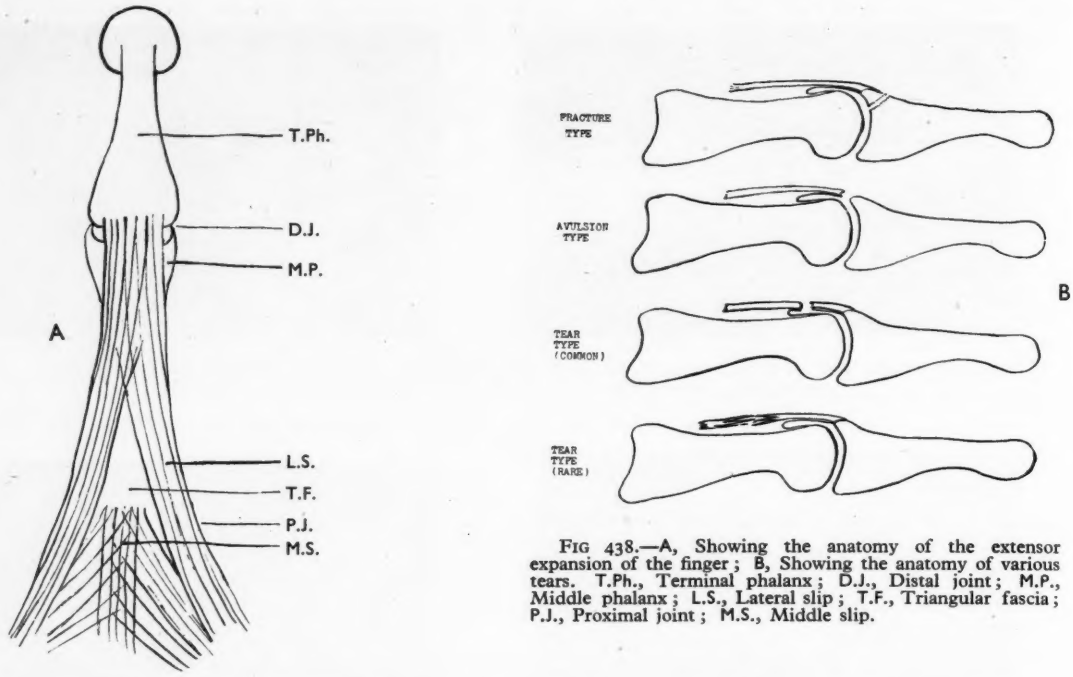


FIG 438.—A, Showing the anatomy of the extensor expansion of the finger; B, Showing the anatomy of various tears. T.Ph., Terminal phalanx; D.J., Distal joint; M.P., Middle phalanx; L.S., Lateral slip; T.F., Triangular fascia; P.J., Proximal joint; M.S., Middle slip.

Table I.—ANALYSIS OF 24 CASES OF DIVISION OF FLEXOR DIGITORUM PROFUNDUS AND SUBLIMIS

CASE NO.	NAME	AGE	TIME OF REPAIR		FINGER	TENOLYSIS	TYPE OF REPAIR	ACTIVE MOVEMENT		FLEXION DEFORMITY
			Immediate	*Delayed*				*P.I.P.*	*T.I.P.*	
1	E. B.	21		5/12	R. little	—	Palmaris graft	50°	Flicker	40°
2	A. F.	27		5/52	L. middle	+	Direct suture	95°	30°	—
3	W. D.	31		4/12	L. little	—	Palmaris graft; repair after fracture of prox. phalanx united	65°	Flicker	30°
4	B. W.	19		3/12	L. ring	+	Palmaris graft	65°	20°	30°
5	T. McE	35		10/52	R. middle	—	Sublimis used as graft	40°	—	20°
6	B. S.	20	I		L. little	—	Sublimis used as graft (Pulley lost)	80°	50°	—
7	D. W.	21	I		L. middle	+	Palmaris free graft	90°	20°	20°
8	L. M.	56	I		L. little	—	Profundus repaired	80°	20°	—
9	J. R.	16	I		L. index	+	Profundus repaired	100°	60°	—
10	Q. H.	31	I		R. ring and middle	—	Profundus repaired Profundus repaired	90° 80°	70° 60°	10° 20°
11	P. W.	39	I		L. index	—	Profundus repaired	No follow-up, patient left country		
12	N. R.	19	I		R. index	—	Profundus repaired	100°	60°	10° (D.I.P.)
13	R. J.	22	I		R. middle	+	Profundus repaired	90°	20°	10°
14	R. S.	20		5/12	R. little	+	Profundus repaired	100°	70°	—
15	R. R.	29	I		L. index	+	Profundus repaired	60°	30°	25°
16	D. S.	28		1/12	L. middle	+	Profundus repaired	100°	20°	—
17	W.	56	I		L. little	—	Profundus repaired	95°	20°	10°
18	B. B.	19	I		L. middle	+	Profundus repaired	120°	75°	—
19	L.	24		2/12	L. middle	—	Palmaris graft	70°	30°	20°
20	S.	29		3/12	L. middle	—	Palmaris graft	90°	40°	—
21	C.	2½	I		R. middle	—	Profundus suture	? 50°	20°	—
22	R.	11	I		L. ring	+	Profundus repaired	110°	60°	—
23	K. G.	15		5 yr.	R. middle	+	Palmaris free graft	90°	20°	50° (D.I.P.)
24	D. B.	3	I		L. little	—	Profundus repaired	95°	60°	20°

24 cases { 10 secondary repairs 5 + tenolysis; 14 primary repairs 6 + tenolysis } Good results, 20 cases; Bad results, 3 cases.

Table II.—Analysis of 12 Cases of Division of Flexor Digitorum Profundus Only

Case No.	Name	Age	Time Before Repair	Teno-lysis	Type of Repair	Degrees of Active Movement		From 180° Flexion Deformity
						P.I.P.	*D.I.P.*	D.I.P.
25	W. R. C.	16	3/12	—	Direct suture	100°	30°	—
26	M. S.	34	8/52	—	Profundus sutured to sublimis	95°	20°	25°
27	D. B.	56	4/12	—	Direct suture	90°	20°	—
28	T. E.	40	I	—	Direct suture	110°	40°	20°
29	J.W.	21	I	—	Direct suture	100°	50°	20°
30	L. D.	29	S 3/52	+	Direct suture	90°	30°	—
31	G. C.	33	S 8/52	—	Direct suture	95°	50°	10°
32	G.	35	I	—	Direct suture	100°	30°	—
33	S.	45	I	+	Direct suture	90°	50°	—
34	K. E. T.	30	I	—	Direct suture	100°	80°	—
35	S.	32	I	—	Direct suture	100°	50°	—
36	A.	26	I	+	Direct suture	90°	40°	—

Three cases of tenolysis which was performed for loss of proximal interphalangeal joint movement after initial suture. Small range of flexion accepted giving patient a strong finger.

Table III.—Analysis of 6 Cases of Division of Flexor Pollicis Longus

Case No.	Name	Age	Time Before Repair	Teno-lysis	Type of Repair	Degree of Active Movement	
						Flexion	*Extension*
37	S.	8	4/52	—	Free graft*	50°	—
38	W. A.	48	I	+	Direct suture	80°	10° hyper-extension
39	F. W.	53	I	—	Direct suture	50°	—
40	B. L.	16/12	I	—	Direct suture	80°	20° hyper-extension
41	C. M.	35	8/52	—	Free graft*	40°	—
42	M.	37	I	—	Direct suture	50°	—

* Free graft by performing ' Z ' lengthening at wrist and moving tendon down as a free graft.

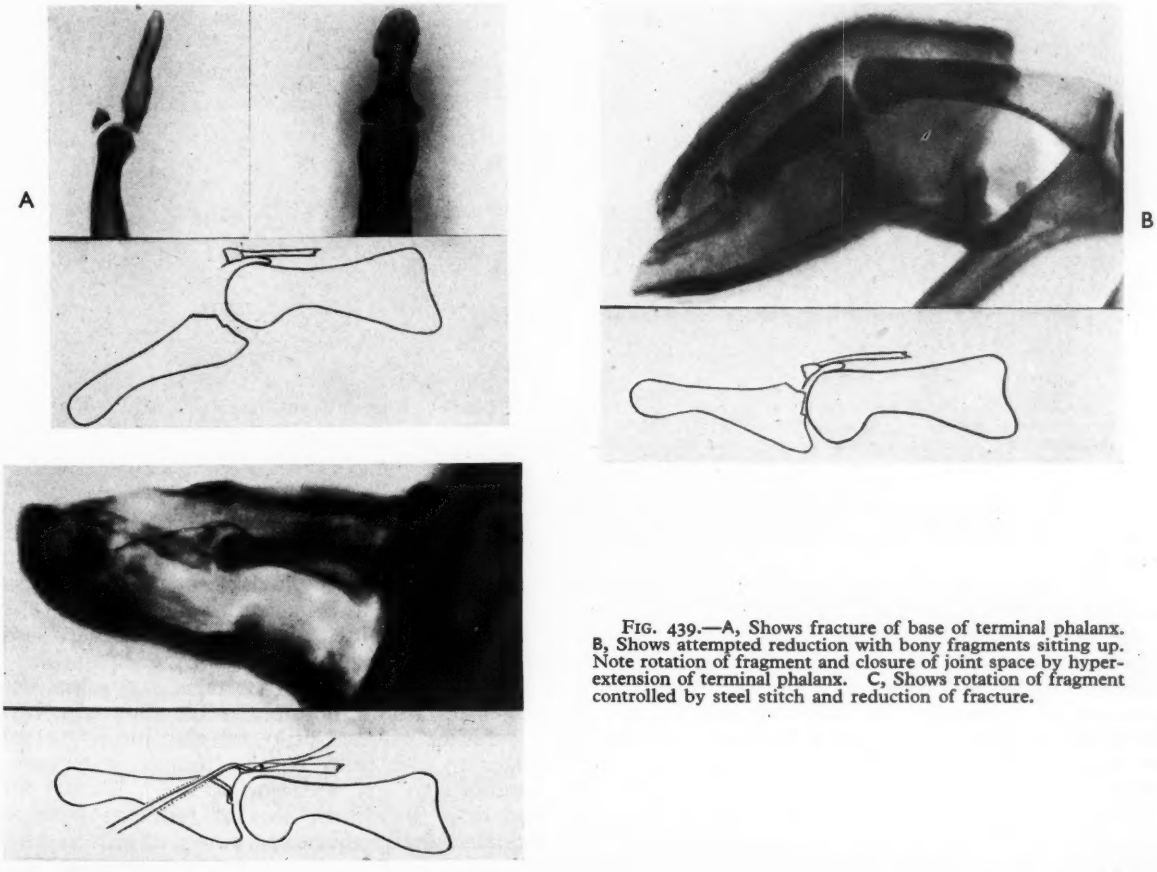


Fig. 439.—A, Shows fracture of base of terminal phalanx. B, Shows attempted reduction with bony fragments sitting up. Note rotation of fragment and closure of joint space by hyper-extension of terminal phalanx. C, Shows rotation of fragment controlled by steel stitch and reduction of fracture.

SUMMARY

A series of injuries to the flexor tendons of the fingers and thumb, occurring inside the tendon-sheaths, is reported.

Immediate repair was undertaken where possible, and of those cases repaired as an immediate procedure, where both sublimis and profundus tendon had been damaged, nearly 50 per cent gave good results.

It was found necessary in nearly half the number of cases to free up adhesions either to keep a useful range of movement or to get a full range of movement.

If care is taken to repair the pulleys of the flexor sheath at the primary procedure, the bow-springing tendon is rarely encountered.

The indications for the repair of the severed profundus tendon are discussed.

A small series of cases of divided flexor pollicis longus is reported, with a suggestion that thumb interphalangeal joint movement is extremely important for any precision or fine tool worker.

Tables of the cases and some clinical photographs are also included.

II. TEARS OF THE EXTENSOR TENDONS AROUND THE TERMINAL INTERPHALANGEAL JOINT

The results of treating recent extensor-tendon tears around the interphalangeal joints of the fingers by closed manipulation and splint or plaster fixation (as advocated by Sterling Bunnell, Watson-Jones, and others) have been disappointing in our hands. The immediate result on the removal of the plaster invariably showed a fully extended joint, but within 48 hours the flexion deformity present before treatment recurred in approximately 50 per cent of our patients. However, it was observed that some of these apparently bad results, after a period of six or more months, gradually corrected themselves and the final result was a fairly good functional range of flexion and extension of the interphalangeal joints. But in the majority of the bad results the deformity remained unchanged. Further, some of the joints subsequently became very painful.

The function of the terminal joint of the finger is not unimportant. The loss of controlled apposition of the pulp of the index or middle finger to the pulp of the thumb is a very real handicap to any precision worker. In the middle and little fingers the loss of terminal joint movement adversely affects the power of grip so essential to heavy work.

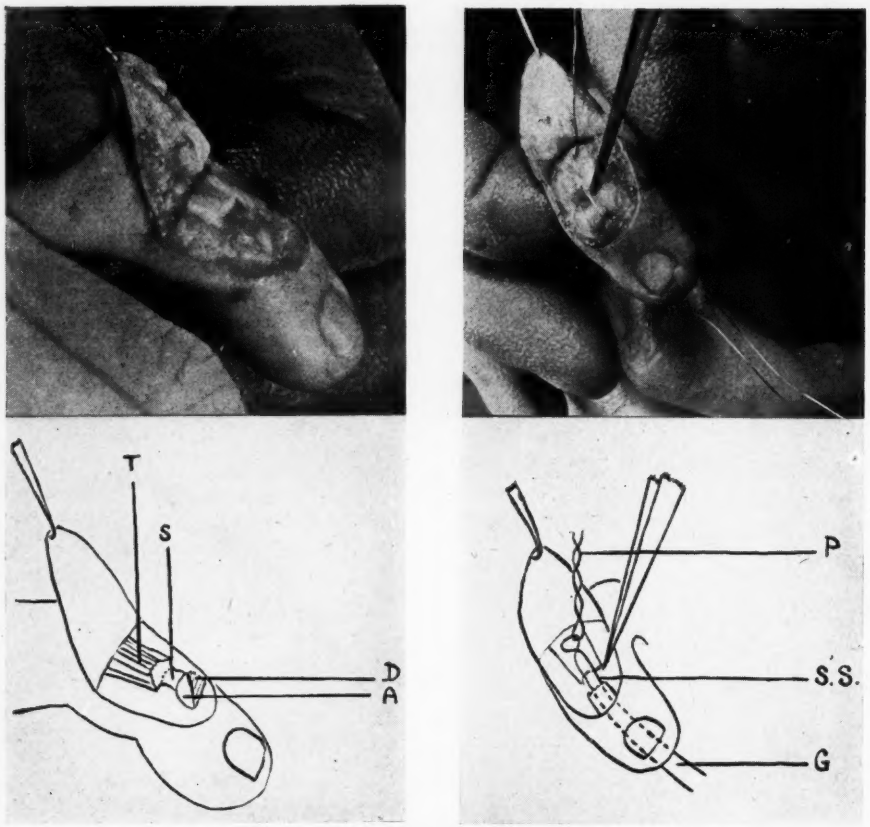


FIG. 440.—Photographs showing tear of extension tendon over head of middle phalanx with method of repair. T, Proximal portion of torn extension tendon; S, Synovial reflection; D, Distal portion of tendon; A, Articular cartilage on head of middle phalanx; P, Pull out wire; S.S., Stainless steel suture; G, Free ends of wire to be tied over gauze pad.

This study was therefore commenced in an attempt first to demonstrate the exact surgical anatomy of these common lesions and so to find the explanation of the variability of results of ' closed ' treatment, and secondly to explore the possibility of more satisfactory methods of repair.

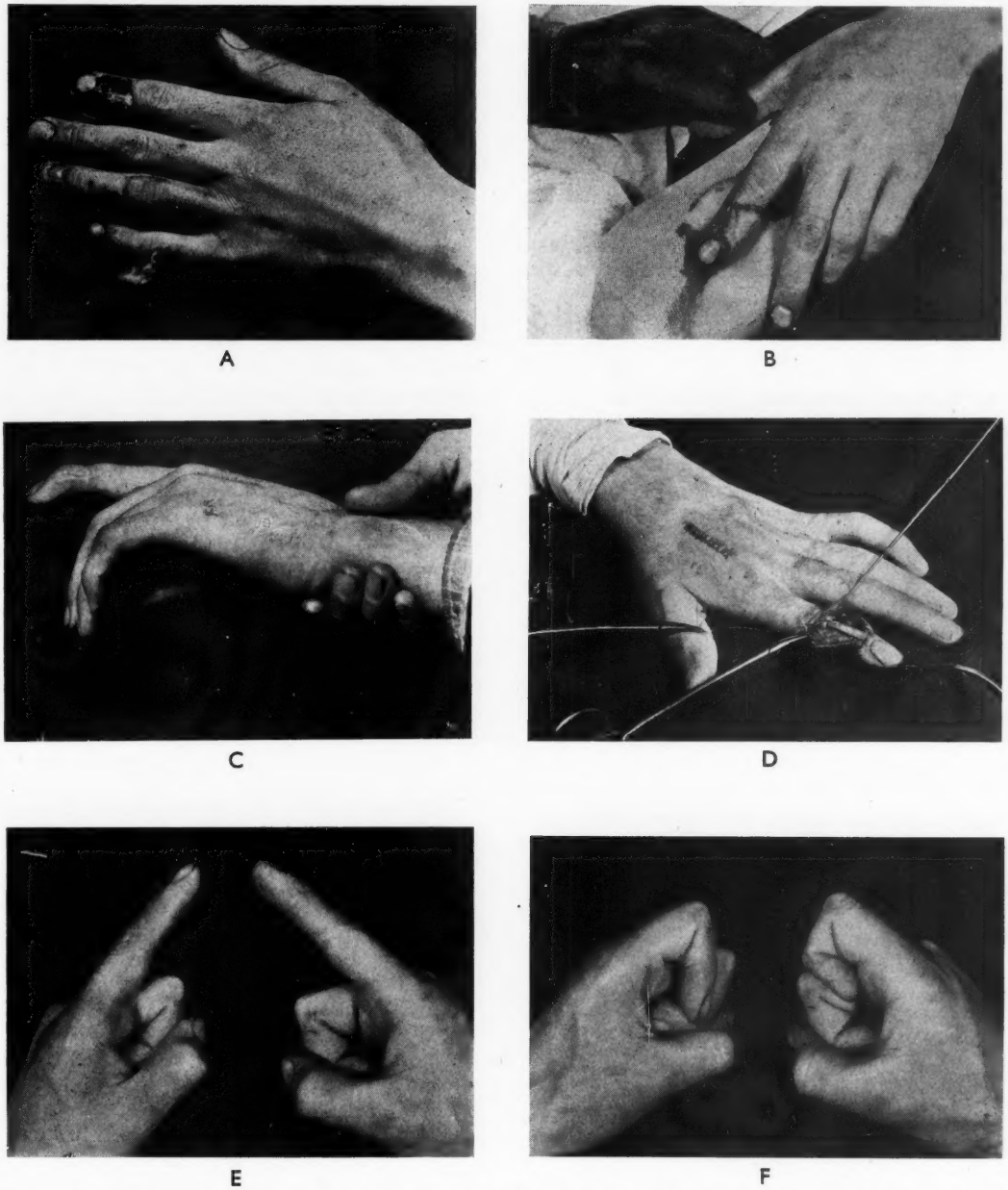


FIG. 441.—A, Grinding-wheel injury of left index finger with loss of all soft tissues including the extensor tendon; B, Primary skin cover by flap graft; C, Typical deformity; D, Free tendon graft; E, F, End-result, extension and flexion.

This paper is based on a personal experience of treating 60 of these injuries over a period of twelve months at the Birmingham Accident Hospital.

THE ANATOMY OF THE EXTENSOR EXPANSION OF THE FINGER

The lumbricals and interossei, together with the long extensor tendon of the finger, form an expansion covering the posterior aspect of the proximal phalanx. After the insertion of the central part of this expansion into the base of the middle phalanx, the lateral bands (of this extensor expansion) pass distally on either side of the middle phalanx, fuse on the dorsum of the middle of the shaft of this phalanx, and then run down as a flat tendon to be inserted into the base of the terminal phalanx (*Fig.* 438).

Over the terminal interphalangeal joint the tendon forms the main part of the joint capsule. There it is lined by synovial membrane which is intimately attached to the under surface of the tendon. When the interphalangeal joint is in the fully extended position this synovial membrane is lax. As the

joint is flexed the slack is taken up as the extensor tendon passes over the articular head to its insertion at the base of the distal phalanx.

Surgical Anatomy of the Various Tears (*Fig.* 438).—"If a finger in active extension is suddenly and forcibly over-flexed at its terminal joint, as for example by a blow from a cricket ball or when the tip of the finger is 'stubbed' in bedmaking, the extensor tendon may be torn." The tear of the tendon in this form of violence is not a clean cut division as when cut with a knife, but is ragged like an old rope that has first been frayed and then pulled apart. Further, the site of the tear, particularly in its relationship to the synovial membrane, is not constant.

Open operation on these tears has revealed two main groups of mallet finger :—

1. The tendon insertion at the dorsal margin of the base of the terminal phalanx is avulsed with a fragment of bone.

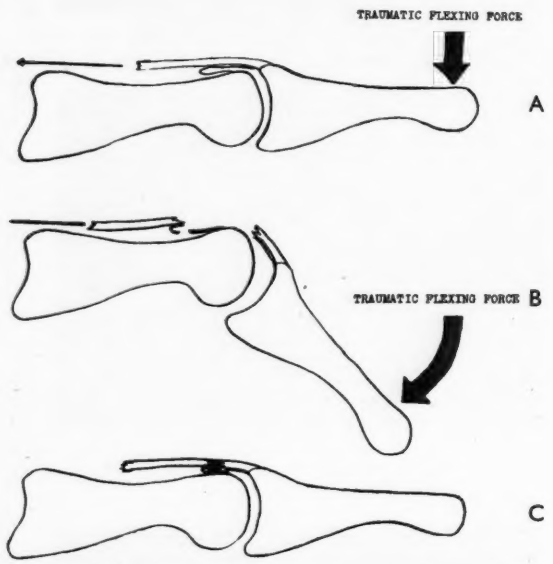


FIG. 442.—A, Shows muscle pull of extensor expansion; B, Shows tear of tendon and synovial reflection; C, Shows block of fibrous tissue forming dense adhesions between head of middle phalanx and extensor tendon.

This group can be diagnosed by X rays. The results of treatment of this group depends upon the accuracy of the reduction of these fractures. If by 'closed' manipulation an exact reduction can be obtained and held, then the results of 'closed' treatment are excellent. But if 'closed' manipulation fails to reduce the fracture, results of 'closed' treatment in this group are bad.

Two main causes for failure by closed reduction of these fractures have been found at operation :—

a. A large tongue-shaped piece of articular cartilage is avulsed with the bone fragment. (This articular cartilage is not visible on radiography.)

At open operation it was found necessary first to reduce the articular cartilage into its correct position before the main bone fragment could be exactly reduced. An open operation is essential to obtain reduction in this type of fracture.

b. The detached bone fragment visible on radiography is sometimes so grossly rotated that hyper-extension of the terminal joint alone fails to reduce the fracture. In fact hyper-extension merely closes the joint space, leaving the avulsed fragment still grossly rotated.

In order to correct this rotatory displacement a stitch is inserted into the distal end of the tendon close to the dorsal margin of the rotated fragment and then passed through the raw surface of the base of the terminal phalanx by means of a small drill hole. Pulling on this stitch corrects the rotation and holds the detached fragment exactly against its parent bone. (*Fig.* 439.)

2. The non-fracture type of mallet finger.

This comprises 75 per cent of the total in this series. It is caused by a tear of the extensor tendon at some point between its insertion and the triangular fascia of Bunnell. (*Fig.* 440.)

These cases can be divided into two main groups :—(*a*) Those where avulsion of the tendon is from the base of the terminal phalanx; and (*b*) Those that have occurred proximally to this level. In both these groups there was some damage to the synovial reflection over the head of the middle phalanx. Gross damage to the synovial reflection is the undoubted cause of the proportion of bad results by closed plaster treatment of this group. For example, *Case* 4 after plaster treatment had a persistent 60° flexion deformity of the terminal joint. Open reduction showed that the extensor tendon had become firmly adherent to the neck of the middle phalanx at the site of the synovial damage and that this firm adhesion prevented the extensor tendon pulling through to control the terminal interphalangeal joint.

Included in this group were 3 cases where there had been fraying of the main body of the extensor tendon between the junction of the lateral slips and the commencement of the synovial reflection.

Fig. 441 shows the functional result obtainable by free tendon graft.

Where there has been gross damage to the synovial reflection, and adhesions between the repaired tendon and the neck of the middle phalanx could be confidently anticipated (*Fig.* 442), we have followed several techniques :—

a. Repair by free graft with paratenon attached.

b. Use of local rotation and soft-tissue flaps to cover the raw surfaces of the bone under the repaired tendon.

c. Free paratenon graft under the repaired tendon.

None of these techniques has been completely successful, though all of them have given improved results.

RESULTS

(*Tables IV, V*)

A total of 61 cases of mallet fingers have been reported, and, of these cases, 22 were mallet fingers due to either a crushing or a cutting injury. The remaining cases were all of the closed type. Of these, there were 10 cases which showed the fracture at the base of the terminal phalanx, 12 cases that showed an avulsion of the tendon from its insertion to the base of the terminal phalanx, and 17 which showed a tear at some point along the tendon. Synovial reflection damage was seen in both the avulsion type of mallet injury and the tear type. It will be seen

that 16 of these cases are reported with synovial damage. In those cases which had a tear of the tendon, particularly over the middle phalanx, more than half of them showed synovial damage.

In those cases that had intact synovia, there was a mean flexion deformity of about 8°, with a range of active movement of 59°. Of those cases which showed tears of the synovia, there was a mean flexion deformity of about 17°, i.e., about twice the deformity of those which had no damage to the synovia. These cases also showed a mean range of flexion through 45°.

The 3 cases in *Table V* marked with an asterisk are cases where the extensor tendon had been frayed

Table IV.—Analysis of 61 Cases of Mallet Finger

Synovium Torn						Synovium Intact					
Case No.	*Name*	*Age*	*Treatment*	*Degree of Flexion Deformity*	*Degree of Active Flexion*	*Case No.*	*Name*	*Age*	*Treatment*	*Degree of Flexion Deformity*	*Degree of Active Flexion*
1	S.	44		20°	50°	33	H.	56	Plaster then op.	25°	50°
2	P.	47	Graft	25°	45° C						
3	S.	16	Graft	—	40° C	34	Y.	43		—	80°
4	H.	33	Plaster then op.	10°	50°	35	S.	51		15°	65°
						36	H.	16	Fr. type op.	—	80°
5	C.	27		—	55° C	37	F.	35		10°	60°
6	B.	49		25°	30°	38	B.	17		10°	60° C
7	R.	51		20°	50°	39	M.	37		—	60° C
8	G.	40		25°	40°	40	D.	37		10°	50°
9	A.	60		30°	20°	41	W.	37	Fr. type plaster	10°	80°
10	D.	43		15°	45° C						
11	C.	40		15°	60° C	42	W.	60		—	40°
12	W.	17		—	40° C	43	D.	51	Fr. op.	—	40°
13	B.	29		30°	20° C	44	T.	38		10°	70°
14	B.	49	Graft	30°	30° C	45	T.	16	Fr. M and op.	—	80°
15	B.	19		—	30° C						
16	C.	17		10°	80° C	46	G.	16	Fr. M and op.	10°	60°
17	S.	30		25°	45° C						
18	A.	63		10°	20°	47	T.	14		—	80° C
19	L.	24	Graft	30°	40°	48	F.	15		—	70° C
20	B.	36	Graft	10°	50°	49	H.	38		25°	40°
21	A.	46	Graft	20°	40°	50	W.	25		—	30° C
22	S.	41	Graft	30°	35° C	51	T.	35		15°	45°
23	S.	48		25°	45°	52	S.	56		10°	60° C
24	B.	36	Graft	—	80°	53	D.	35		10°	60°
25	H.	43		25°	45°	54	C.	35	Fr. M.	15°	60°
26	S.	28		15°	35°	55	B.	40		—	55°
27	P.	43	Arthrodesis	—	—	56	H.	39	Fr. M. and op.	—	50°
28	B.	18		15°	70° C						
29	G.	29		30°	30° C	57	M.	40		—	50°
30	J.	26		25°	50°	58	B.	6		10°	70°
31	M.	8		—	50° C	59	O.	49		15°	45°
32	P.	26		10°	45°	60	P.	31	Fr. M.	20°	40°
						61	G.	35	Fr. M. and op.	—	70°
32 cases						29 cases					

Fr., Fracture; M., Manipulation; Op., Operation; C, Compound type of injury.

Table V.—Analysis of Closed Type of Mallet Finger (39 Cases)

Fracture Type (10 *Cases*—25 *per cent of Total*)

Name	Age	Flexion Deformity	Active Flexion	Method of Treatment
H.	56	25°	50°	M. Op.
H.	16	—	80°	Op.
W.	37	10°	70°	P.
D.	51	—	40°	Op.
T.	16	—	80°	M. Op.
G.	16	10°	60°	M. Op.
C.	35	15°	60°	M.
H.	39	—	50°	Op.
P.	31	20°	40°	M.
G.	35	—	70°	M. Op.

Avulsion Type (12 *Cases*—33 *per Cent of Total*)

Name	Age	Flexion Deformity	Active Flexion	Condition of Synovium
S.	44	20°	50°	S.D.
H.	56	25°	50°	
H.	33	10°	50°	S.D.
D.	37	10°	50°	
W.	60	—	40°	
T.	35	15°	45°	
A.	63	10°	20°	S.D.
D.	35	10°	60°	
H.	43	25°	45°	S.D.
B.	40	—	55°	
J.	26	25°	50°	S.D.
B.	36	10°	50°	S.D.

Tear Type (17 *Cases*—42 *per cent of Total*)

Name	Age	Flexion Deformity	Active Flexion	Condition of Synovium
Y.	43	—	80°	
S.	51	15°	65°	
F.	35	10°	60°	
B.	49	25°	30°	S.D.
R.	51	20°	50°	S.D.
G.	40	25°	40°	S.D.
T.	38	—	70°	
H.	38	25°	40°	
L.*	24	30°	40°	S.D. Free graft
A.*	46	20°	40°	S.D. Free graft
S.	48	25°	45°	S.D.
B.*	36	—	80°	S.D. Free graft
S.	28	15°	35°	S.D.
B.	6	10°	70°	
W.	44	20°	40°	
A.	60	30°	20°	S.D.
P.	26	10°	45°	S.D.

* These cases were the rare (Type IV) fraying injuries (*see Fig.* 438).
M., manipulation; Op., operation; P., Plaster; S.D., Synovium damaged.

and torn, between the head of the middle phalanx and the junction of the two lateral slips of the extensor mechanism. The remainder of the cases in this latter table were those where there was a tear over the head of the middle phalanx.

SUMMARY

An investigation was made into the pathology of the mallet finger and the results are recorded of the exact site of the tear in a series of consecutive cases.

It is recognized that the recurring flexion deformity from the plaster-treated mallet finger may be due to many factors, such as late application of plaster, inadequate plasters, or plasters becoming loose or cracked, but attention is drawn to the fact that in this series the flexion deformity of those cases that had synovial damage was roughly twice that of those that had not. Moreover, the amount of active movement that was recovered was on the average 20° higher in those cases where there was no damage to the synovium.

The operative technique of treating the mallet finger based on the recognition of the different types of lesion, can on the whole offer the patient a useful finger with the minimal degree of flexion deformity. This method of treatment is particularly useful in all cases of mallet finger that make their first attendance some days after the injury. The main indication for operation is, however, when a finger is presented which shows a fully flexed terminal interphalangeal joint without any power of extension.

Acknowledgements.—I wish to acknowledge the help given to me by Mr. W. Gissane, Ch.M., F.R.C.S., Clinical Director of the Birmingham Accident Hospital. His timely advice and encouragement both with the clinical work and the preparation of this article was invaluable.

Mr. J. F. V. Larway of the Photographic Department for the preparation of the illustrations.

Messrs. I.C.I. (Metals Division), Witton, for permission to use the X-ray photographs of the original injury (*Case* 61).

The secretarial staff of the Birmingham Accident Hospital for their co-operation in preparing the tables of results and in securing the adequate follow-up.

PERIRENAL TUMOURS

WITH A REPORT OF A FURTHER CASE OF PERIRENAL FIBROSARCOMA

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A PERIRENAL tumour must be considered in the differential diagnosis of any large abdominal mass. Such tumours though very uncommon are important in that they are frequently amenable to surgery in spite of their great size. They are generally benign, occur most frequently in middle-aged women, and are characterized by an insidious onset and progress, the huge size of the mass being the first sign to attract attention in many cases. Pressure effects on other organs appear to be late manifestations, while recurrence and malignant changes may follow an apparently successful surgical removal.

In 1919 perinephric tumours were defined by Lecéne as " such retroperitoneal neoplasms as seem to have intimate anatomic relations with an otherwise normal kidney, and which appear to have developed at the expense of either the fibrous capsule or the cellulo-adipose covering of the kidney ".

True perirenal tumours are therefore lipoblastomas or fibroblastomas, benign or malignant. The rare form of perirenal lymphangioma properly belongs to the ordinary retroperitoneal tumours, since there is no lymphatic tissue in the renal capsule.

PERIRENAL LIPOMA

By far the commonest type of perirenal tumour is the lipoma, more than 200 of which had been described up to 1938 (Howard and Suby). The pathology has been discussed by several writers, including Hunt and Simon (1928), who point out that there is no clear-cut division between simple hypertrophy of the perirenal fat and a true perirenal lipoma. The tumours can be of considerable size and are entirely retroperitoneal, varying in consistency from patches of calcification to areas of semicystic mucoid material. The vascularity is not great, and there is generally a capsule which permits of relatively easy enucleation. Sarcomatous areas may occur according to Ewing (1942), either primarily or in the not infrequent recurrences after removal.

In a review of perirenal lipomata in 1937, Ockulay and Douglas credit Morgagni with having seen the first case in 1760. Since that date reports have continued to be added to the literature, but it is not until quite recent years that positive diagnoses have been made during life. The youngest case recorded by Ockulay and Douglas was 15 days old: the oldest, over 70 years; and these authors consider that about 35 per cent of all retroperitoneal lipomata are perirenal in origin. Bilateral instances are recorded.

Although lipomata and fibrolipomata are the commonest types of perirenal tumours, lipomyxoma, liposarcoma, sarcoma, and fibrosarcoma are also described, according to the preponderance of the fibrous or fatty tissue and the degree of malignancy. These tumours may be quite small but are generally very large, some being classed as huge, as exemplified by a 69½ lb. liposarcoma described by Hirsch and Wells in 1920. Calcification and areas of cystic and mucoid degeneration are common, but here again, in spite of the size, surgical enucleation is often possible.

PERIRENAL FIBROSARCOMA

Perirenal fibrosarcoma arising from the true renal capsule is a very rare tumour. Lecéne (1919) reviewed the literature and collected 15 cases of sarcoma in 113 perirenal tumours; and in 1938 Howard and Suby extended the review, bringing the total up to about 24 cases. Their own case was

a man of 68 years who survived surgical removal of a large tumour, and progressed very well for about three to four months until a recurrence was palpated. He died eight months after operation.

The case to be reported brings the total number of recorded perirenal fibrosarcomata up to about 26.

CLINICAL PICTURE

The characteristic feature of all perirenal tumours appears to be their insidious onset and progress. Pain, or in fact symptoms of any kind, may be absent or slight until there is a large palpable abdominal tumour. Jacobs and Hoffman (1932) state that in perirenal fibrosarcomata "the chief complaint is pain of dull aching character in the lumbar region", and results from pressure of the neoplasm upon the lumbosacral nerves. Many writers do not mention this fact, at least until the later stages in the disease, and it appears that vague backache rather than pain is more common. The author's patient did not complain of pain at any time. With the growth of the mass the patient tends to lose weight, and becomes tired and listless until the large tumour is in marked contrast to the emaciated rather than cachectic host.

Pyrexia is frequently present in cases of renal tumours, particularly of the hypernephroid type. Hyman (1925) states that it is present in 20 per cent of all cases and is due to toxic products in the tumour, not to associated infection or necrosis. Pyrexia is recorded in several of the reported perirenal fibrosarcomata (Jacobs and Hoffman, 1932). Gastro-intestinal symptoms and at times vague backache are amongst the earlier symptoms, but in spite of the gross displacement of the kidney, with perhaps deformity of the calices, pathological disturbances such as hydronephrosis are rare, while, in general, urinary symptoms are seldom recorded. Pressure signs may result in œdema of the lower extremities and genitalia, varicocele, hæmorrhoids, shortness of breath, and ascites from portal obstruction. Renal ischæmia from pressure changes may obviously occur, and marked improvement in hypertension was recorded in a 40-year-old male patient after removal of a 26½-lb. perirenal lipoma together with the kidney (Pfeiffer and Gandin, 1946). The blood-pressure before operation was 170/112, and by the seventy-second day it had dropped to 120/80. This improvement appeared to have been maintained nine months later.

DIAGNOSIS

Most of the recorded tumours have only been diagnosed at operation or autopsy, chiefly because of their rarity and lack of any typical signs or symptoms. The large size of the mass tends to favour a diagnosis of an inoperable abdominal carcinoma. For this reason, the case to be recorded later was not fully investigated for several months.

The commonest tumours entering into the differential diagnosis are large ovarian cysts, ascites, pancreatic cysts, fibroids, and pregnancy.

The diagnosis should be borne in mind in any large, rapidly growing abdominal tumour in an adult of over 40 years complaining of vague indigestion, backache, and lassitude. The tumour is smooth, rounded, or lobulated and soft, though calcified areas will feel hard and will simulate malignancy. Free peritoneal fluid may be present to confuse the picture.

If the condition is suspected, modern investigations should be able to make a positive diagnosis. A plain radiograph, apart from demonstrating the soft tissue shadow, will show elevation of the diaphragm and perhaps displacement of the heart. Gastro-intestinal films may be very helpful in that the intestines may be grossly displaced without being directly affected. Urine analysis is generally normal, but the most valuable single investigation is probably the excretion pyelogram. The kidney with its function undisturbed may be grossly displaced, the ureter is carried towards or across the middle line, while a lateral view will show the renal pelvis in front of the vertebral column. No other tumour will do this to a normal kidney.

TREATMENT

Whatever the size, and in spite of the tendency to local recurrence, the ideal treatment of these tumours is probably surgical enucleation at the earliest possible moment. Ascites, œdema, and varicosities, wasting, or gastro-intestinal symptoms should not deter the surgeon from exploring such a tumour, since the recovery following successful removal is dramatic. Early removal will lessen the chances of compression signs and the possibility of malignant changes. As previously mentioned, Howard and Suby (1938) reported a case of perirenal fibrosarcoma which did very well for three or four months after removal, but developed a recurrence and died eight months after operation. They therefore consider that surgery has no place in the treatment of perirenal fibrosarcoma, and advocate deep therapy from the beginning.

The important point, of course, is that one does not know whether the tumour is a lipoma, fibroma, or sarcoma before it has been removed, and since deep therapy is not usually very effective in connective tissue tumours, it seems unwise to leave the mass undiagnosed and untreated. The literature does not appear to record a case of fibrosarcoma successfully treated by deep therapy alone.

The transperitoneal approach is the easiest and commonest route, particularly where the mass extends into the pelvis and over the middle line. Nephrectomy will probably be necessary since the kidney is usually buried inside the tumour mass, but there is more likelihood of being able to save the kidney in the pure lipomatous tumours than in the fibrolipoma or sarcomatous masses. A useful discussion on the enucleation of such tumours and their relation to the pancreas and the blood vessels of the colon, etc., is given by Holmes (1920). The tumours are confined to the capsule of Gerota and will enucleate without danger to the other organs, the major blood-supplies coming from the renal pedicle. The dangers are shock and hæmorrhage, but any major bleeding must come from accidental injury to the mesenteric vessels, the vena cava, spleen, or liver. The recorded post-operative morbidity includes peritonitis, injury to the blood-supply of the gut, phlebitis, and pulmonary complications.

PROGNOSIS

In spite of marked temporary relief of symptoms after surgery, the prognosis is bad; recurrences are

frequent and they tend to undergo malignant change, so that early surgery is of great importance. Pemberton and McCaughan (1933) quote Von Wahlendorf as claiming a 54 per cent cure rate with a 25 per cent operative mortality; 14 per cent recurred, while 22 per cent were untreatable. These cases were all perirenal lipomata. The prognosis in fibrosarcomata is much worse than this.

CASE REPORT

A 42-year-old woman was first admitted to the hospital in January, 1945, with an incomplete abortion. The uterus was curetted and no abdominal abnormality was complained of or detected. Her hæmoglobin was only 60 per cent, but this was thought to be due to her abortion, which had occurred five days prior to admission. She had one grown-up daughter, and apart from a partial thyroidectomy five years previously, had never been seriously ill in her life.

FIG. 443.—Plain radiograph. Left-sided shadow easily visible below brim of pelvis. Areas of calcification scattered throughout the tumour mass.

The patient was next seen in the out-patient department in July, 1946, nineteen months later. She had noted a painless swelling in her abdomen three months previously, and had been referred to a hospital where the students were told that she had an inoperable carcinoma, her doctor being subsequently notified of this fact. However, she had no other symptoms until six weeks previously, when she developed general malaise and lassitude, frequent vomiting and a rapid loss of weight. During the last two weeks she suffered from nocturnal frequency of micturition and obstinate constipation.

ON EXAMINATION.—Inspection revealed a well-developed woman with a soft mobile goitre involving the left lobe of the thyroid gland, but causing no toxic manifestations. Even when fully dressed, a large left-sided abdominal tumour was noted. Examination showed that the patient had lost considerable weight, the skin of her loins and thighs hanging in folds. Her respiratory, cardiovascular, and nervous systems were normal, but she had a raised temperature of 100·4° F., and stated that she frequently had a temperature in the evening. Abdominal palpation revealed a firm notched irregular mass filling up the left half of the abdomen, extending from under the costal margin to below the anterior superior iliac spine. Mobility appeared to be limited by the size, rather than by attachments to other structures. It could be pushed forward from the loin, which it filled completely, while a band of colonic resonance was detected over its extreme lateral aspect.

Although a tentative diagnosis of enlarged spleen was considered in view of the absence of any renal symptoms, the renal tract was X-rayed, and the plain film showed the huge tumour outline extending below the pelvic brim, with areas of calcification scattered throughout its substance (*Fig.* 443).

FIG. 444.—Excretion pyelogram. Areas of calcification are seen to be well outside the clearly defined renal outline. Note displacement of ureter.

The excretion pyelogram revealed a normally functioning left kidney pushed slightly towards the middle line, with the ureter displaced over the vertebral column. The renal outline could be clearly demarcated from the tumour mass and the areas of calcification, but there was no respiratory excursion of this kidney at all. The right kidney was normal in all respects (*Fig.* 444).

A diagnosis of retroperitoneal tumour was made in view of the ureteric displacement, combined with the fact that the colon remained lateral to the mass, thus rather excluding an enlarged spleen.

Special Investigations.—

Blood-pressure: 140/85.

Blood-picture: R.B.C. 4,160,000; Hb 70 per cent; C.I. 0·8; W.B.C. 13,150; Neutrophils 73 per cent.

Blood-urea: 27 mg./100 ml.

Blood group: O.

Urine: No albumin or sugar. A very few pus cells and coliform bacilli in a centrifuged specimen. Culture—a few colonies of coliform organisms.

OPERATION.—An intravenous blood-drip transfusion was started, and under pentothal cyclopropane anæsthesia, administered by Dr. H. J. V. Morton, the abdomen was opened by a long left paramedian incision which liberated much clear, free fluid. The tumour completely filled up the left half of the abdomen, covered over by posterior parietal peritoneum which was in contact with the anterior abdominal wall. Stretched tightly over this mass were the vessels of the left colon, which was wedged down in a gutter almost in the axillary line. After incising the peritoneum lateral to the gut, mobilization of the colon medially was tedious but uneventful. The full extent of the tumour could then be assessed. It extended from under the dome of the diaphragm down to the brim of the true pelvis. The ureter was found disappearing into the anteromedial border of the mass in its lower portion where it was divided and tied. No kidney was palpable.

FIG. 445.—Gross specimen showing kidney after it had been displaced from the deep sulcus in which it was buried. The renal capsule could not be freed from the tumour. (× ⅓.)

Apart from its sheer bulk, no great difficulty was encountered in shelling the tumour out of the retroperitoneal space. It was surprisingly avascular except in the region of the renal pedicle, where the vessels just disappeared into the mass. Final removal was achieved after mass clamping and subsequent individual ligature of the pedicle. Closure of the gap in the posterior parietal peritoneum presented no difficulties, and the wound was finally closed in layers reinforced by nylon tension sutures. Drainage was not employed.

PROGRESS.—It was fully expected that the patient would be troubled with some degree of paralytic ileus after the extensive gut mobilization, but the various measures which were held in readiness for such an occurrence were not required.

Convalescence was uneventful, the patient being discharged on the fifteenth post-operative day.

When last seen over a year later, she had gained a stone in weight and stated that she felt very fit again. No obvious signs of recurrence of the tumour could be detected.

PATHOLOGY.—The fresh specimen measured 11 × 8½ × 6 in., but shrank a little during fixation (*Fig.* 445). Blunt dissection at the point of entry of the renal vessels into the tumour opened up a deep hilum in which was buried the kidney. The latter could only be removed by a subcapsular enucleation, the capsule itself being fused to the tumour tissue in most places. *Fig.* 446 shows one of the large cystic spaces full of old blood-stained gelatinous material.

I am indebted to Dr. H. Rogers for the following pathological report:—

E. P. Perirenal Tumour. The specimen consists of a large partly lobulated, or bossed tumour with a kidney of normal shape and size embedded in a crevice. The tumour is 10 in. long, 7 in. broad, and 5 in. in depth, and weighs 6 lb. 2½ oz. The surface is smooth and the consistency firm. Some fat is visible in the pseudo-capsule.

On section the main mass appears to consist of firm fibrous tissue with a few semitranslucent areas except at the lower pole, where there are two circular areas of gelatinous material.

Blocks of tissue were taken from different parts and sections stained by the usual routine methods.

Microscopically most areas show bundles of spindle-shaped cells with large hyperchromatic nuclei, while

FIG. 446.—Cut surface showing one of the large cystic spaces filled with chocolate-coloured gelatinous material.

in others the arrangement is more irregular with nuclei varying in size and shape. Giant nuclei and occasional multiple nuclear aggregations are scattered through these more irregular areas. No epithelial elements were found and no fat was demonstrable in any blocks. (*Figs.* 447, 448.)

Histologically the tumour is regarded as a fibrosarcoma.

DISCUSSION

The case of perirenal fibrosarcoma just presented shows many features typical of all perirenal tumours. Approximately 70 per cent of perirenal tumours are found in women between the ages of 40 and 60 years, lipomata being much the commonest type recorded. They have a very rapid rate of growth and do not cause symptoms until the mass is quite large. It was known that the woman described above had developed her huge abdominal mass in the nineteen months between her two hospital admissions, while her symptoms only became noticeable during the last three months.

In spite of the fact that the kidney was completely engulfed in the tumour, the calices were not

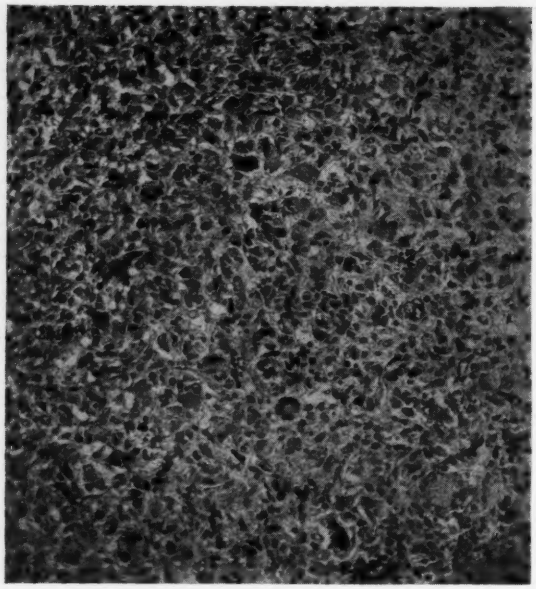

FIG. 447.—Microphotograph of section of tumour. (× 75.)

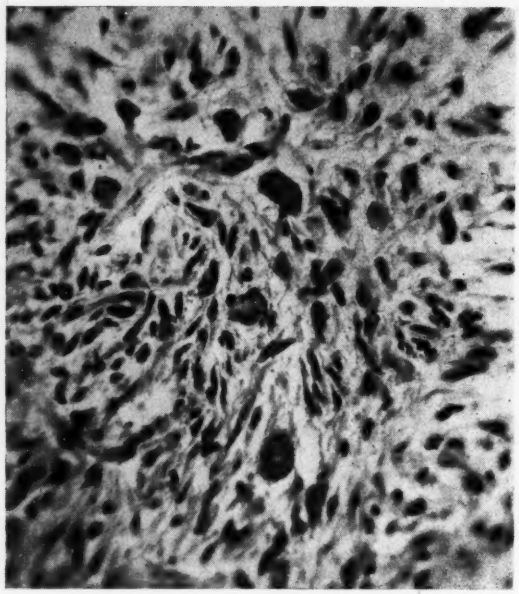

FIG. 448.—High-power view. (× 230.)

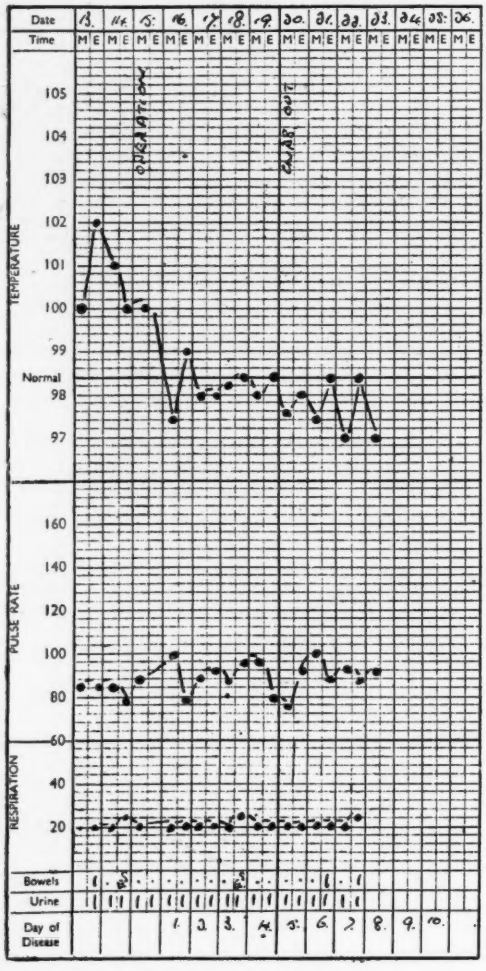

FIG. 449.—Temperature chart showing return to normal almost immediately after removal of tumour.

deformed, and the renal function was apparently undisturbed. The displacement of the ureter is a characteristic feature of such tumours.

The fever which may accompany renal tumours is well demonstrated by this patient's chart (*Fig.* 449), which shows a dramatic return to normal after removal of the tumour.

Perirenal growths of any type are extremely rare, while only approximately 25 examples of perirenal fibrosarcoma have been previously recorded. The case described above is the only perirenal tumour in the last 110,000 hospital admissions.

Recurrence after surgical removal is more than likely in all of these tumours, and the recurrences from simple lipomata may even be malignant, but, in spite of this, surgical enucleation as early as possible appears to be the best method of treatment. Nephrectomy will probably be necessary.

Radiotherapy alone offers no hope of a cure, though post-operative irradiation is favoured in America.

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AN OSSEOUS DYSTROPHY WITH MANY PSEUDO-FRACTURES

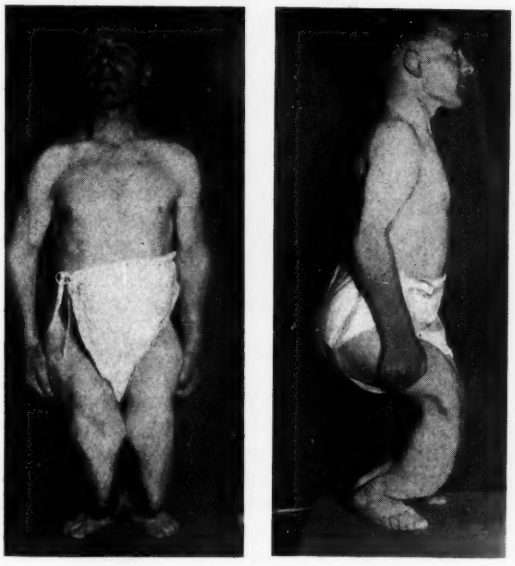
By J. F. CURR, Edinburgh

A young man attending the Royal Infirmary, Edinburgh, in 1943, with a minor complaint, was also noticed to be the victim of a disabling skeletal deformity. He was unwilling to be admitted as an in-patient to have the condition fully examined, or to have any treatment for it. During attendance as an out-patient, however, several investigations were carried out.

CASE REPORT

History.—Male, age 25, cobbler by trade. There was no history of deformities in other members of his family. It was impossible to obtain any reliable account of his infancy and early childhood, but it appeared that he had been delicate when young and had always been small for his age. Walking had been difficult and for as long as he could remember the legs had been bent, though getting worse in the last ten years. There was no history of any fracture and to his knowledge he had not been confined to bed for serious illness or injury.

On Clinical Examination.—The patient was a dwarf, 3 ft. 7 in. in height and 5 st. in weight. The very severe deformities are shown in *Figs.* 450, 451. He



Figs. 450, 451.—Photographs of patient, showing the deformities.

was capable of walking, though slowly and with difficulty, and it seemed surprising that he was even able to attempt it, so advanced was the degree of bowing of the thighs and legs. It produced pain on the front of the legs, but there was no tenderness on pressure. Scoliosis was quite severe, but did not seem to cause any trouble. The skull was of nearly normal size and shape and the features were kindly and well formed. His disposition was quiet and amiable and the intelligence quite good. The sclerotics were of normal colour and there was no swelling in the neck. There was no evidence of cardiovascular disease or digestive disorder. A moderate degree of anæmia was recognized, but a blood examination was not carried out. The urine contained albumin but showed no other abnormality, and the only urinary symptom was polyuria. The blood-pressure was within normal limits, but an ophthalmoscopical examination was not made. There was no evidence of syphilis.

On Radiological Examination.—In addition to the deformities obvious clinically, the outstanding feature was the presence in many bones of areas of discontinuity of osseous tissue which were of the nature of fractures. There were, in fact, pseudo-fractures, also known as Looser's zones. Most of them involved only part of the thickness of the bones, but always the concave aspect, never the convex; others implicated the entire thickness and might have passed for ordinary fractures. All the epiphyses were united. The examination was carried out first in 1943 and repeated in 1945, but no change took place in the bones during that time.

Tibiæ and fibulæ: The anteroposterior bowing was extreme, the lower ends being almost at right angles to the upper. The fibulæ were hypertrophied and in both tibiæ and fibulæ new bone was laid down on the concave aspects, causing increased thickness of the cortical bone. Incomplete fractures were present on the concave aspects, there being eight in the left fibula, one in the left tibia, and seven in the right fibula. There were also two complete fractures in the left tibia and one in the right tibia. The fractures were to a large extent symmetrical (*Figs.* 452, 453).

Figs. 452, 453.—Radiographs of right and left tibiæ and fibulæ showing the almost symmetrical fractures.

Femora: The femora were rather shorter and thinner compared with the tibiæ, but the degree of anteroposterior bowing was not quite so extreme. There was no deformity of the head and neck. Symmetrical fractures were present in the shafts, two on each side, the degree of completeness varying (*Fig.* 454).

Pelvis: A severe degree of trifoliate pelvis was present and there was a complete fracture of the right pubis. The trabeculations were coarse and there was increased density in the region of the acetabula (*Figs.* 454, 455).

Vertebræ: A severe scoliosis existed. The trabeculations were coarse and the density was greater than normal. There was a slight degree of concavity of the upper and lower surfaces of the vertebral bodies (*Fig.* 456).

Ribs: There were several fractures, some nearly complete (*Fig.* 456).

Upper limbs: There were no fractures in the humeri or forearm bones. The humeri were not well modelled, being shorter and broader than normal and showing irregular trabeculations.

Skull: The skull was of nearly normal size and shape, but there was increased density of the base. A Wormian bone was present at lambda.

Abdomen and chest: No abnormality was visible, except for the bone deformities.

Fig. 454.—Radiograph of femora, showing normal head and neck but symmetrical fractures in the shaft on each side.

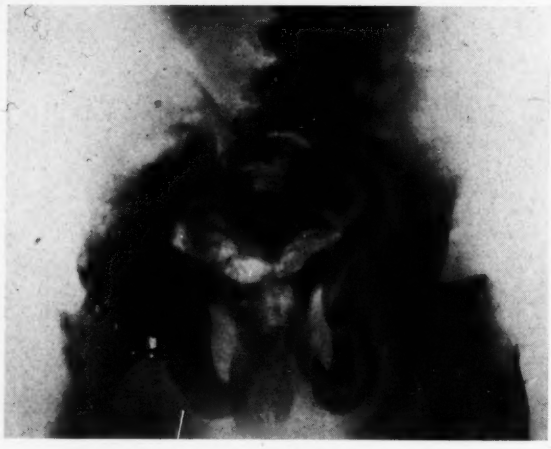


Fig. 455.—Radiograph showing trifoliate pelvis.

BIOCHEMICAL INVESTIGATION.—The following readings were obtained :—

Serum-calcium, 9·9 mg. per cent.
Blood-phosphorus (inorganic), 4·2 mg. per cent.
Serum-phosphatase, 62 units (modified Kay).

The calcium was within normal limits, the phosphorus was at the high limit of normality, and the phosphatase was definitely high (normal, 30 units)

DISCUSSION

THE BONE DEFORMITIES

The dwarfism must have been associated with some generalized disorder of growth, but it was undoubtedly exaggerated by the deformities which alone reduced the stature by many inches.

The severe bowing of the bones of the lower limbs, the deformities of the pelvis and spine, the Wormian bone in the skull, and the pseudo-fractures were not in themselves distinctive of one particular condition but were merely evidence of a generalized bone-softening process, the causes of which will be discussed. Weight-bearing on the softened bone had had most profound effects and had given rise to the bowing of the femora, tibiæ, and fibulæ, the trifoliate pelvis, and the vertebral deformities. In addition, the fibulæ showed considerable hypertrophy, presumably in an attempt to compensate for the weakness of the tibiæ. The bones of the upper limb showed little change, thus confirming the influence of weight-bearing.

Fig. 456.—Radiograph showing scoliosis and slight concavity of upper and lower surfaces of vertebral bodies.

Pseudo-fractures.—The pseudo-fractures were so uncommon as to warrant special notice. Camp and McCullough (1941) gave the following list of possible causes of pseudo-fractures: osteomalacia, rickets, late rickets, renal rickets, cœliac disease, steatorrhœa, sprue, early and late osteogenesis imperfecta, hyperparathyroidism, hyperthyroidism, Paget's disease, adrenal-pituitary dystrophy, severe acidosis, hyperglycæmia, congential syphilis, osteomyelitis, insufficiency fracture, and blood dycrasias. The only feature in common is softening or weakening of the bony framework or excessive load on the bones. To this list may be added the so-called Milkman's syndrome.

These pseudo-fractures are often known as Looser's zones, after Looser (1920), who gave a full account of them. According to him, they represent small local infractions due to mechanical irritation caused by deformity or excessive strain. The traumatic change itself is a summation of small cracks which gradually divide the bone and to which the bone is particularly susceptible because of generalized disease. Brailsford (1944) considered it conceivable that fragile cancellous trabeculæ do

fracture but that periosteum and more fibrous elements remain intact. Localized absorption of the fractured cancellous tissue results in a zone of decalcified bone, which is thus relatively weak. The parallel edges around it are of dense bone, in some respects resembling a pseudarthrosis.

The fractures may occur in the absence of bowing, but where that is present they are believed to occur almost always on the convex aspect. In my personal case, on the other hand, they were present on the concave aspect and were thus quite atypical. Brailsford (1943) described one case of osteogenesis imperfecta in which the incomplete fractures were on the concave aspect at the key point of the curvature where compression was greatest.

The symmetry of the fractures is not surprising as both lower limbs are affected by the causative condition and as presumably the stresses are applied equally to the two sides and at the same levels. The ribs are affected by respiratory movements and the pull of muscles, which take the place of weight-bearing stresses.

In a pseudo-fracture it is always possible that, unless relieved of pressure, marked displacement may take place and convert it into a true fracture. Alternatively, callus formation and union may occur or the appearance of the pseudo-fractures may remain stationary for several years, as in my personal case.

DIFFERENTIAL DIAGNOSIS

Several of the conditions already listed can be excluded, but a few demand consideration in discussing the diagnosis in my personal case. There was also the possibility of a combination of disorders, Brailsford (1943), for example, quoting a case where hunger osteomalacia was superimposed on osteogenesis imperfecta.

Osteogenesis Imperfecta.—Brailsford (1943) classified this condition as occurring at different ages, including puberty, adolescence, and adult life, as well as in infancy. In one of his cases there were pseudo-fractures on the concave aspect of the bones, distinctly resembling those in my personal case. Against the diagnosis, however, were the absence of previous fractures, the lack of a suggestive family history, and the absence of blue sclerotics.

Milkman's Syndrome.—Milkman (1930 ; 1934) described a condition of " multiple spontaneous idiopathic symmetrical fractures ", which he considered a definite entity and which has since come to be known after him. In his original patient it appeared at the age of 40, and there was no previous history of bone deformities or curvatures. In a slowly progressive manner, multiple pseudo-fractures developed without trauma or obvious cause, until ultimately fractures in each femur became complete and did not unite, a fatal issue ensuing ; no treatment was of avail. Later, there were published accounts of somwhat similar cases. Edeiken and Schneeberg (1943) reported the case of a dwarf who had always walked with difficulty and had scoliosis but no limb deformity ; multiple pseudo-fractures were present and the blood-chemistry was normal. Green and Golding (1937) reported a case of multiple pseudo-fractures in a female of small stature but with no deformity. Camp (1941), on the other hand, was of the opinion that this was not a separate entity and that the cause was to be sought among the conditions already mentioned. My personal case showed a strong resemblance to Milkman's syndrome, in as much as no obvious aetiological factor was present.

Endocrine Disorders.—There was no evidence to support such a diagnosis, hyperparathyroidism being the most important to exclude.

Rickets and Osteomalacia.—As the brothers and sisters were of normal development, it was improbable that one alone could have suffered from any severe dietary and vitamin deficiency. In addition to the well-known deformities, rickets may produce spontaneous cracks and fractures during the active stage, but union then takes place. It does not produce fractures persisting into adult life and therefore true rickets in early childhood could be ruled out.

The various deformities and pseudo-fractures were quite suggestive of osteomalacia, even although occurring in a male. The dwarfism, however, showed the condition to be of much longer duration than the hunger type arising after cessation of growth.

A further possibility was late rickets or juvenile osteomalacia occurring at the age of 4 or 5, and causing deformation of the bones. The fractures may then have developed and the altered mechanical stresses caused them to persist. It is unlikely, however, that this state could have continued for twenty years, the high phosphatase reading suggesting a lesion still active.

Cœliac Rickets.—When severe, this may produce changes in bone very similar to those of osteomalacia. Parsons (1927), in a severe case of cœliac rickets, demonstrated the presence of fractures which, however, united firmly with treatment of the cœliac disease. The history in the early years of life was lacking in my personal case, but there had been no severe diarrhœa for as long as he could remember ; biochemical examination, also, did not support the diagnosis.

Renal Rickets or Renal Osteodystrophy.—Chronic renal disease in childhood may be of particularly insidious onset and give rise to severe metabolic disturbances with consequent changes in bone. Brailsford (1944) recognized two types of bony change and the radiological appearances of my personal case were quite compatible with his type B. In this, the patient is a dwarf with a severe metabolic disturbance, and the long bones of the lower limb, the pelvis, and the spine show pseudo-fractures and profound pressure deformities as severe as in the worst degrees of true osteomalacia. Parsons (1927) showed a stunted boy of 16 with very severe deformities due to renal rickets, but the results of the radiological examination were not reproduced.

The high serum-phosphatase figure and the blood-phosphorus figure at the upper limit of the normal were suggestive, but, in the absence of more definite clinical features, a diagnosis of renal osteodystrophy could not be established with certainty in my personal case.

Comment on Diagnosis.—It was not believed possible to establish a final diagnosis. Of the conditions discussed, the most suggestive were renal osteodystrophy, juvenile osteomalacia, and Milkman's syndrome. Reports of similar previous cases indicate the difficulty in arriving at a correct

conclusion and the mere acceptance of a doubtful entity like Milkman's syndrome serves to confirm this. Unfortunately impracticable in this case, a wider range of tests is recommended, such as renal function tests and the investigation of the absorption and excretion of calcium and phosphorous.

TREATMENT

Whatever the cause, treatment was unlikely to of much avail now. In the renal osteodystrophy, Liu and Chu (1943) recommended the following: a low-phosphorus, low-protein, high-calcium diet and the administration of alkalis, dihydrotachysterol, and iron. Such treatment improved the intestinal absorption and retention of calcium and phosphorus, bue recalcification of the bones was not observed by them.

Although Milkman (1930; 1934) had no success in his own case, Edeiken and Schneeberg (1943) noted in nineteen previous cases that there were several reported cures with calcium, vitamins A and D, and arsenicals. My own case had apparently been treated in the past with such preparations, but obviously without success.

Had the patient been willing to submit to surgical measures, osteotomies would have been necessary to correct the bowing of the femora, tibiæ, and fibulæ. Probably four separate operations would have been required and the risks were considered too formidable to justify.

SUMMARY

A severe osseous dystrophy is described, an extreme degree of bone softening causing widespread deformities, particularly in the lower limbs, pelvis, and spine. An outstanding feature was the presence of multiple pseudo-fractures. The exact cause of the dystrophy was not certain.

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REHABILITATION OF FRACTURES

BY J. J. R. DUTHIE, J. G. MACLEOD, AND R. J. G. SINCLAIR

THE principle of segregation of fractures in special units was adopted by Böhler and others many years ago, but up to the time of the present war this principle had only a limited acceptance in this country. Fracture clinics had been established in a few hospitals and good results reported (Corbett, 1930; Hosford, 1935), but the report of the B.M.A. Committee on Fractures (1935) revealed that the position was far from satisfactory. The majority of fractures were still being treated in general surgical wards. Statistics collected by the committee showed that the results obtained in organized fracture clinics were superior, in terms of disability period and permanent incapacity, to those obtained in general hospitals and by general practitioners. Hey Groves (1935) published a similar series of figures based on 1081 fractures treated in organized clinics and 276 treated in general hospitals and in private practice. His figures amply confirmed those of the B.M.A. Committee. An interdepartmental committee was appointed under the chairmanship of Sir Malcolm Delevingne to investigate the rehabilitation of persons injured by accident. This report was published in 1939 and constitutes the most comprehensive survey of the problem available in the literature. Their investigations revealed that in the year 1935, 1,303,478 people were treated in hospitals in Britain for injuries resulting from accidents of all kinds. Fractures were present in 204,738 cases. In the opinion of the committee, if both the number and degree of disablement were considered, fractures and allied injuries constituted much the most important group of injuries by accident. They emphasized in the strongest terms the need for the organization of a comprehensive fracture service throughout the country, based on the principle of the establishment of fracture departments in all major hospitals which would undertake the primary treatment and rehabilitation of all fractures admitted to the hospital. The establishment of rehabilitation centres for the reconditioning of workers returning to heavy industry was regarded by the committee as an essential feature of the service. Medical supervision must be maintained until full working capacity has been restored. The recommendations of the Delevingne committee were largely implemented by the health authorities in the organization of the Emergency Medical Service. Orthopædic units were established and the principle laid down that fractures requiring long-term treatment should be concentrated in these centres. Other hospitals were designated and equipped to treat fractures of a less severe type. In so far as service conditions would allow, similar arrangements were made in military hospitals.

During the war the authors were associated with the work of military convalescent depots in Scotland and had a unique opportunity of seeing the results of the adoption of the principles of concentration of fractures in special units and the maintenance of

medical supervision until maximum function had been restored. All military casualties returning from abroad and all men remaining in hospital at home for more than twenty-one days were automatically sent to these depots for reconditioning before returning to active duty. During the period July, 1940, to June, 1945, approximately 55,000 men passed through military convalescent depots in Scotland. A description of the organization of training and results obtained in one of these depots has already been published (Duthie, 1944). During the period July, 1940, to January, 1945, 32,193 men passed through two of these depots, amongst which were 3121 cases of fractures. A survey of the literature showed that although some figures had been published showing the disability periods and incidence of permanent impairment of function in groups of fractures (Corbett, 1930; Hosford, 1935; Hey Groves, 1935; B.M.A. Committee on Fractures, 1935; McBride 1936; Delevingne Report, 1939), none was satisfactory, in the sense that accurate standards of final assessment were not given and follow-up was in most cases incomplete. In view of the importance of fractures as a source of disability and disablement in this country it was felt that it might be of value to present the results obtained under circumstances where treatment was continuous, follow-up complete, and final assessment based upon standard tests of function.

ORGANIZATION, METHODS OF TREATMENT, AND STANDARDS OF ASSESSMENT

Service cases were transferred to convalescent depots from hospital when they reached a stage when they were no longer in need of nursing care and were able to walk without undue difficulty. In the case of fractures the majority had received primary treatment in one or other of seven large orthopædic units. Plasters had been removed before transfer to the depot. On admission cases were medically reviewed and placed in a grade of training suitable to their stage of recovery. Those with considerable residual disability were placed in the lowest grade, where their physical activities were confined to non-weight-bearing remedial exercises. Men less severely handicapped were placed in the next grade, where their activities were of a more strenuous character and included short route marches. The next grade involved strenuous physical training, games, and route marches up to 8 miles. In the highest grade, reached only by those men with little or no residual disability, training was stepped up to the very high standard expected of the A1 soldier and included a 17-mile route march carrying equipment, a 3-mile cross-country run, a strenuous assault course, heavy log exercises, and a full range of games of a competitive character. No man was discharged from the depot in category A1 who had not successfully complied with this rigorous standard. All cases were medically reviewed at weekly intervals. A full range of physiotherapeutic treatment was available for men in the two lower grades. Occupational therapy was used on a limited scale for men with disabilities of the forearm, wrist, or fingers. Weight and pulley exercises were used extensively in the treatment of local weakness of muscle and were found to be of the greatest value. At the weekly review, progress was assessed and cases were upgraded as improvement took place. Final assessment of residual disability was reached when repeated failure to complete the activities of any grade showed that the limit of functional restoration had been attained. As has already been stated, any man failing to complete the highest grade had his medical category lowered before discharge.

RESULTS

Military medical categories are complicated by such factors as eyesight, hearing, intelligence, and constitution, but for the purpose of this paper they can be roughly interpreted as follows:—

Category A—No significant residual disability.

Categories B and C—Moderate to marked residual disability.

Category E—Severe disability, unfit for further military service.

The problem of assessment of results is simplified by the fact that of the 3121 fractures to be reviewed, 2654 were sustained by men in category A1, i.e., men 100 per cent fit before injury. Men who failed to attain the highest grade were assessed as follows: if they failed to get higher than the lowest grade they were placed in Category E unless they had some special qualification which would enable them to continue to be usefully employed in the army. Those failing to complete the intermediate grades were placed in Category B or C. It will thus be seen that assessment was based entirely on the impairment of performance produced by residual disability. In civil practice it is probable that a high proportion of the men graded down to category B would be considered to have no residual disability likely to interfere with their capacity for work, as few occupations make such high demands upon physique and stamina as the activities of the highest grade in the convalescent depot. The average civilian with no physical disability would probably require some preliminary training before attempting

Table I.—Analysis of the Medical Categories of 3121 Fractures

	Simple	Compound	Total
Number of cases	2774	347	3121
Men in Category A before injury	2374	280	2654
Men returned to duty in Category A	1945	108	2053
Men downgraded from Category A	429 (18 per cent)	172 (61·4 per cent)	601 (22·6 per cent)
Men in Categories below A before injury	400	67	467
Men returned to duty in original category	375	64	439
Men further downgraded	25 (6·3 per cent)	3 (4·5 per cent)	28 (6·0 per cent)
*Men discharged from the service	17	7	24

* These 24 cases are included in the figures for downgrading.

these tests. When these considerations are borne in mind, it will be seen that the estimation of full recovery is conservative.

The fact that 77·4 per cent of men in Category A (*see Table I*) were returned to duty in that category is a remarkable testimony to the high standard of primary treatment made available to those men in military and E.M.S. hospitals. There was only one large military hospital in Scotland treating significant numbers of fractures during the period under review. It may appear surprising that only a small percentage of low category men were further downgraded on account of residual disability, but the explanation is simple enough. These men were employed at a lower level of physical activity on account of some pre-existing defect and only when residual disability was of such a degree as to limit still further their capacity for work was it necessary to lower their medical category. In actual practice it was possible in many instances to raise the medical category of such cases, as a result of the improvement in their general condition following physical reconditioning.

It is generally accepted that the results following compound fractures are less satisfactory than those following simple fractures. This is amply confirmed by the figures presented in *Table I*; 61·4 per cent of category A men were downgraded following compound fractures as compared with 18 per cent following simple fractures. A further examination of the records revealed that sequestrectomy was performed in 129 cases of compound fracture; 111 of these men were medical category A before their injury. Only 25 of these men could be returned to duty in category A, the remaining 86 being downgraded (77·5 per cent). In only 7 cases, however, was it necessary to recommend discharge as unfit for further service. This indicates that modern methods of treatment of compound infected fractures have vastly improved the prognosis in these cases.

Table II.—Results in Fractures involving the Upper Limbs, Trunk, and Lower Limbs

	Upper Limb	Trunk	Lower Limb
Number of cases	800	399	1922
Men in Category A before injury	658	338	1658
Men returned to duty in Category A	490	259	1304
Men downgraded from Category A	168 (25·5 per cent)	79 (23·3 per cent)	354 (21·3 per cent)
Men in Categories below A before injury	142	61	264
Men returned to duty in original category	130	59	259
Men further downgraded	12 (8·5 per cent)	2 (3 per cent)	14 (5·3 per cent)
*Men discharged	6	3	15

* These 24 cases are included in the figures for downgrading

The results in fractures involving the upper limb, trunk, and lower limb are presented in *Table II*. The distribution of these fractures presents no unusual features, the incidence being the highest in the lower limbs, lowest in the trunk, with fractures of the upper limbs occupying an intermediate position. The fact that residual disability necessitating lowering of medical category should be commoner in the upper limbs than in the lower requires some explanation. It is due to the fact that every man in category A must be able to handle a rifle. Minor degrees of limitation of supination or pronation may render this impossible, and any impairment of grip or limitation of movement in either wrist may have an equally disabling effect. As has already been pointed out, minor degrees of functional impairment of this nature might prove no handicap to a civilian, but compliance with the strict standards of assessment necessary in the army rendered down-grading unavoidable in these cases.

In view of the diverse activities of the soldier in a modern army in training and in action, an analysis of the actual causes of individual fractures was considered worth while. Definite information on this point was obtained in 1962 cases and is presented in *Table III*. The very large number undergoing training in Scotland during the period under review accounts for the high proportion of fractures due to training activities and motor accidents. The figures emphasize the very great wastage of manpower which occurs in a modern army undergoing intensive preparation for action.

Table III.—Aetiology in 1962 Fractures

Cause of Fracture	Number of Cases	Percentage of Total
Enemy action	292	15·0
Physical training	118	14·6
Military training	169	
Football	266	14·6
Other games	21	
Accidents with motor vehicles	591	30·0
Miscellaneous causes	505	25·8
Total	1962	100·0

Although football is undoubtedly the most popular game in the Army, it accounts for an unduly high proportion of serious injuries. In a previous analysis of 6635 surgical cases admitted to military convalescent depots in Scotland (Duthie, 1944) it was found that 27 per cent were due to fractures and 21 per cent due to knee injuries. In 60 per cent of cases the initial injury in lesions of the semilunar cartilages was sustained while playing football (Duthie and Macleod, 1943–4). The fact that football accounts for a very significant proportion of both fractures and torn cartilages must give rise to doubts as to whether its recreational value is not outweighed by the high incidence of serious injuries.

Details of the duration and degree of disability following simple and compound fractures are presented in *Table IV*. Calculation of the average

Table IV.—Duration of Disability and Results of Treatment in 2774 Simple and 347 Compound Fractures

Classification	Number of Cases		Average No. of Days in Hospital		Average No. of Days in Depot		Average No. of Days off Duty		Percentage Discharged in Original Category		Percentage Medically Downgraded	
	Simple	*Compound*	*Simple*	*Compound*	*Simple*	*Compound*	*Simple*	*Compound*	*Simple*	*Compound*	*Simple*	*Compound*
Phalanges (hand)	62	15	71	77	25	37	96	114	90·3	62·5	9·7	37·5
Metacarpals	98	37	65	106	26	37	91	143	91·0	49·0	9·0	51·0
Scaphoid (wrist)	125	2	110	146	45	27	155	173	69·6	50·0	30·4	50·0
Radius	209	17	83	134	32	36	115	170	81·6	61·6	18·4	38·4
Ulna	43	18	82	113	33	43	115	156	83·7	77·4	16·3	22·6
Radius and ulna	18	8	132	112	42	42	174	154	50·0	50·0	50·0	50·0
Humerus	105	43	96	168	37	43	133	211	79·8	39·5	20·2	60·5
Femur	65	36	183	174	47	47	230	221	63·3	32·3	36·7	67·7
Tibia (shaft and ends)	214	35	114	172	44	50	158	222	72·5	47·0	27·5	53·0
Tibia (internal malleolus)	45	—	82	—	36	—	118	—	87·7	—	12·3	—
Fibula	424	19	70	103	35	38	105	141	90·3	53·4	9·7	46·6
Tibia and fibula (shafts)	300	38	161	220	51	61	212	281	60·0	13·5	40·0	86·5
Tibia and fibula (Pott's)	244	—	87	—	40	—	127	—	86·9	—	13·1	—
Patella	74	13	90	146	43	52	133	198	71·4	46·1	28·6	53·9
Os calcis	76	5	119	178	50	50	169	228	48·6	40·0	51·4	60·0
Tarsals	17	8	76	117	45	41	121	158	64·7	25·0	35·3	75·0
Metatarsals	198	28	65	116	36	46	101	162	86·2	35·7	13·8	64·3
Phalanges (toes)	77	6	53	89	26	37	79	126	90·9	50·0	9·1	50·0
Skull	18	2	61	201	29	35	90	236	88·8	—	11·2	100·0
Clavicle	116	4	50	119	14	35	64	154	96·5	50·0	3·5	50·0
Scapula	26	12	55	108	24	39	79	147	96·1	75·0	3·9	25·0
Ribs	20	1	53	134	28	55	81	189	80·0	—	20·0	100·0
Vertebræ	124	—	110	—	35	—	145	—	67·8	—	32·2	—
Pelvis	76	—	93	—	37	—	130	—	59·2	—	40·8	—

Table V.—Percentage in which Full Recovery can be expected and Average Duration of Disability in Weeks

90–100 per cent	Weeks	80–89 per cent	Weeks	70–79 per cent	Weeks	60–69 per cent	Weeks	48–59 per cent	Weeks
Clavicle	9	Ribs	11	Humerus	19	Tarsals	17	Pelvis	19
Scapula	11	Skull	13	Patella	19	Vertebræ	21	Os calcis	24
Phalanges (toes)	11	Metatarsals	14	Tibia (shafts and ends)	23	Scaphoid (wrists)	22	Radius and ulna	25
Metacarpals	13	Ulna	16			Tibia and fibula	30		
	14	Radius	16			Femur	33		
	15	Tibia (internal malleolus)	17						
		Tibia and fibula (Pott's)	18						

period of disability for the whole group revealed that the average length of stay in hospital was 95 days, the average number of days spent in the convalescent depot was 36, giving a total time off duty of 131 days. Although the number of compound fractures available for analysis was relatively small, comparison of results with those obtained in simple fractures shows the prognosis to be much more serious both in regard to length of treatment and return of function.

In view of the fact that little information is available in the literature regarding the duration of treatment and the incidence of residual disability in simple fractures, this information has been extracted and summarized in *Table V*. The fact that cases were drawn from fit men serving in the forces limits the value of the figures, but this is counter-balanced to some extent by the fact that the standard of fitness demanded of these men was much above that required in any but a few civilian occupations.

SUMMARY

1. The methods used in the rehabilitation of service cases following fractures are described.

2. An analysis of the results obtained in 3121 fractures is presented, with special reference to the duration of treatment and the degree of residual disability. Attention is drawn to the singular lack in the literature of reasonably accurate estimates of these factors. It is hoped that the figures presented may be of value in the assessment of prognosis.

The figures presented in this paper were collected while the authors were serving as specialists in physical medicine in Scottish Command. The authors are indebted to the D.D.M.S., Scottish Command, for permission to publish them.

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EPIPHRENIC DIVERTICULUM OF THE ŒSOPHAGUS

WITH REPORT OF A CASE TREATED SURGICALLY

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DIVERTICULA of the œsophagus are usually classified according to their anatomical positions as pharyngo-œsophageal, epibronchial, and epiphrenic. The least common are the epiphrenic diverticula which arise from the lower third of the œsophagus within a short distance of the diaphragm. Since, in addition to their rarity, these pouches are not infrequently symptomless, reports of their successful removal are sufficiently scarce to warrant the recording of a further case.

Frequency.—Granet (1933), in a careful review of the literature up to 1933, found a total of 49 cases, but of these only 31 were accepted as definitely proved epiphrenic diverticula.

Vinson (1934) observed at the Mayo Clinic 24 epiphrenic diverticula out of a total of 42 œsophageal pouches.

A further case, complicated by the presence of a carcinoma within the diverticulum, was reported by Cabot (1940).

Aetiology.—Although it is customary to divide œsophageal pouches into pulsion and traction types, Carmen (quoted by Granet) considers that the majority of the epiphrenic diverticula are congenital in origin and that the important factors in their development and enlargement are the negative intra-thoracic pressure, the positive intra œsophageal pressure, and the anatomy of the lower œsophagus. Dessecker (also quoted by Granet) lays stress on the turning of the œsophagus to the left in its lower third so that food boli impinge upon the wall of the œsophagus at the right lower corner of this natural curve, and then an enlargement of the diverticulum occurs downward and to the right. This is further aided by the barrier of the heart and pericardium to the left and anteriorly and of the vertebral column posteriorly.

Although Grey Turner (1946) considers that the beginning of an œsophageal pouch is probably present from early life as a congenital defect and that the increase in size is a gradual process which goes on until about middle life, when symptoms are likely to arise, Raven (1933) mentions a case in which the diverticulum arose in four months. Grey Turner further considers that, if they are really congenital in origin, one might expect to find a definite stenosis of the œsophagus where the pouch arises, as is sometimes found in the small intestine with Meckel's diverticulum, but that he has not come across an example of this sort.

Associated Conditions and Complications.—Epiphrenic diverticulum of the œsophagus is not infrequently associated with some other lesion, particularly cardiospasm.

Moynihan (1927), in his Harveian Lecture, mentions 3 personal cases, one of which was associated with a high degree of cardiospasm, and in Vinson's collected series of 42 cases there was an associated cardiospasm in 8.

Other associated conditions reported by Vinson are carcinoma of the upper portion of the œsophagus, hernia of the cardiac end of the stomach, carcinoma of the stomach, pyloric obstruction, and duodenal ulcer.

The complications that may be encountered are inflammation of the walls of the diverticulum, which may spread to the surrounding parts, ulceration, perforation, and malignant change.

Perforation may be either a sudden catastrophe and involve the mediastinum or the unprepared pleural cavity or a gradual erosion into neighbouring parts such as the left main bronchus.

The occurrence of an epidermoid carcinoma within an epiphrenic diverticulum has been mentioned above.

Diagnosis.—Many epiphrenic diverticula are symptomless and are discovered either during routine radiological investigation or at post-mortem examination. Size, location, and the presence of complications may determine the symptomatology.

Direct symptoms may result from the filling and emptying of the pouch and indirect symptoms will be produced by pressure.

A multiplicity of complaints were noted in Vinson's series: dysphagia, epigastric pain and soreness, vomiting or regurgitation, substernal distress, gas on the stomach, anorexia, belching, bloating, loss of weight, cough, chills and fever, heartburn, nausea, regurgitation of blood, and hiccup.

Barrett (1933) gives the commonest symptoms as difficulty in swallowing and a feeling of fullness in the chest, the explanation being found in the behaviour of the sac during the ingestion of food.

In addition to Vinson's list of symptoms Barrett includes increase in salivation, cardiac pain, and palpitations.

Accurate diagnosis can only be made by X-ray examination, and, as a rule, the radiological appearances are characteristic and unequivocal. Occasionally, however, it may be difficult to differentiate from a thoracic stomach or cardiospasm (*see Fig.* 458).

Œsophagoscopy is rarely necessary, but may in some cases assist diagnosis.

Treatment.—The majority of epiphrenic pouches being symptomless, it follows that only a few require treatment, but once it can be reasonably certain that symptoms are due to the presence of one of these diverticula surgical treatment should be considered.

Three alternative procedures have been advocated —radical extirpation of the sac, anastomosis between the sac and the stomach, and inversion of the diverticulum.

Radical extirpation has been recorded by Clairmont, Fick, and Barrett; the anastomosis operation has been effected by Lotheissen, Kelling, and Clairmont by a subphrenic approach and by Henschen from above the diaphragm (Sauerbruch and O'Shaughnessy, 1937); and the inversion method has been employed by Grey Turner and Lahey (1940).

With the present-day confidence in free thoracotomy a left transpleural approach undoubtedly offers the best access to an epiphrenic diverticulum, although earlier operations were sometimes effected by an extrapleural posterior mediastinal approach or through an upper abdominal incision.

Whenever possible radical extirpation is the ideal and, in the absence of any complication such as sepsis, the pouch is easily freed from the loose connective-tissue bed in which it lies.

If, however, the sac is very large or thick-walled, or has an unusually wide mouth, it is probably wiser to perform an anastomosis of the pouch to the stomach.

Where sepsis is present Grey Turner advocates simple inversion.

The two principal complications that may be encountered after the transpleural operation are leakage from the suture line in the œsophagus and infection, either of the mediastinum or pleural cavity.

Scrupulous care must be taken to ensure complete closure of the œsophagus and Barrett employed two layers of catgut sutures which were covered by a small flap of pleura. A further safeguard is the passage of a Levine's tube through the nose into the stomach so that the patient may be fed through this in the immediate post-operative period.

Finally a drainage tube may be inserted leading from the site of operation to the exterior and brought out through a separate stab wound.

CASE REPORT

H. R., male, aged 47 years.

In November, 1944, he first experienced a sudden attack of pain in the precordial area of the chest which radiated down the left arm. Its onset was sudden and without apparent cause. Some pain lasted for two days. In April, 1945, he had a second attack lasting about half an hour. Soon after lunch on the same day he had a third attack and he attributed this and subsequent attacks to a preceding meal.

In May, 1945, he was admitted to a hospital elsewhere for investigation, and the following report was made: Heart slightly enlarged, with poor distant sounds. B.P. 130/80. Pulse 80. Lungs, abdomen, and C.N.S. normal. Retinal vessels showed slight arteriosclerosis. Urine negative. Radiograph of heart: Atonic heart with some bilateral enlargement. E.C.G. showed no evidence of cardiac disease. Fractional test-meal showed no free HCl; total maximum acidity of 24 c.c. in 2½ hours.

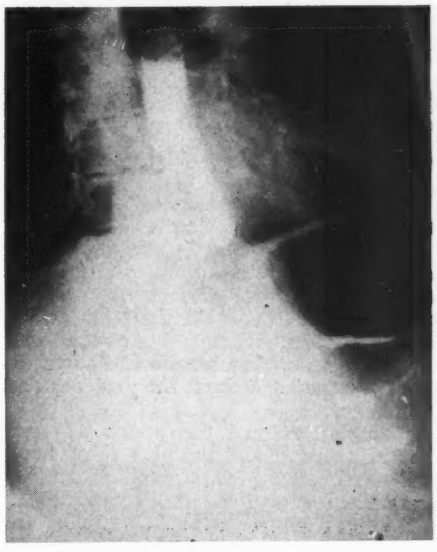

Fig. 457.—Radiograph showing the diverticulum lying to the right of the œsophagus and above the dome of the diaphragm, with the gas-filled fundus of the stomach below the diaphragm. The turning to the left of the œsophagus, which shows no dilatation, is well marked. The outline of the diverticulum is smooth and regular and there is no filling defect.

Cholecystogram: Gall-bladder appears to fill well and contract after a fatty meal.

He was considered to be suffering from a dyspepsia, partly functional and partly achlorhydric, and was discharged in June.

In October, since his attacks of pain continued, he was referred to the Royal Sussex County Hospital by Dr. Eyton Jones for further investigation, with a suggested diagnosis of diaphragmatic hernia. He was seen by Dr. Ivor Balfour, who suspected an œsophageal diverticulum, and X-ray examination by Dr. Guy Whorlow showed a well-defined epiphrenic diverticulum (*Fig.* 457),

As it was considered that this lesion might well be responsible for his symptoms he was admitted to the surgical wards under my care.

OPERATION (Dec. 10).—Anæsthesia was induced with pentothal and an endotracheal cuffed tube was passed.

cyclopropane and oxygen in closed circuit being administered.

With the patient in the right lateral position a long incision was made over the ninth left rib about 8 in. of which was resected subperiosteally. The pleura was

Fig. 458.—Radiograph of a case of cardiospasm, showing gross dilatation of œsophagus above the constricted area. At one point the left wall of the œsophagus is ballooned out and shows some resemblance to a diverticulum. Œsophagoscopy disproved the presence of a pouch.

opened, the pulmonary ligament divided, and the lower lobe of the lung retracted upwards.

The œsophagus was isolated just above the diaphragm and gradually cleared in an upward direction until the diverticulum was reached. The pouch was then freed by gauze dissection. It was found that there was no inflammatory reaction around the pouch, nor was it adherent to any lymphatic glands in the mediastinum. The neck of the sac arose from the posteromedial aspect of the œsophagus.

When completely freed the pouch was seen to be about 3 in. in diameter and the neck fairly broad. The neck was divided between clamps and closed by a double row of catgut. It was invaginated by a third row of interrupted catgut stitches. The area of operation was dusted with sulphanilamide powder and a small red rubber drainage tube inserted into the mediastinum and brought out through a separate stab wound.

The main incision was closed in layers and a gauze dressing applied and anchored with elastoplast.

The patient was returned to bed with continuous oxygen through a B.L.B. mask, and a prophylactic course of penicillin commenced.

Convalescence was complicated by a right basal pneumonia, but there was never any suggestion of a mediastinitis or a left-sided pleural infection.

The Levine's tube—passed before operation—was removed on the third day as a result of the bitter complaints of the patient.

By the fifth day he was taking beef tea, and tea and milk, and was swallowing without difficulty or discomfort, and by the tenth day semi-solids such as bread and milk, ground rice, and Benger's.

The drainage tube was removed on the tenth day.

He was up on the seventeenth day and discharged a month after operation.

PATHOLOGICAL REPORT.—The diverticulum is a rounded sac, about 2 in. in diameter, rather more than hemispherical in shape and slightly elongated in a longitudinal direction. The opening of the sac is $2\frac{1}{2} \times 3$ cm. in diameter.

Macroscopically there is no evident ulceration of the lining and there are no gross tags of fibrous tissue on the exterior surface to suggest severed adhesions.

Histologically the diverticulum is lined by a hyperplastic, but not invasive, type of squamous epithelium. There is no inflammatory reaction and no evidence of ulceration or of gastric mucosal type of epithelium.

SUBSEQUENT PROGRESS.—Since discharge from hospital this man has so persistently complained of flatulence that considerable doubt must be entertained as to whether the diverticulum was, in truth, the cause of his original symptoms.

For some time he continued to get an occasional attack of precordial pain, but this symptom now appears to have subsided.

Five months after operation a barium swallow showed an apparently normal œsophagus.

Nine months after operation the X-ray findings give a slight suggestion of a residual pouch, but this does not retain any permanent collection of barium. The domes of the diaphragm move freely, but the fundus of the stomach is gas-distended and the stomach itself is of a cup-and-spill type by reason of displacement by the gas-distended bowel.

A cholecystogram showed normal findings.

It is worthy of notice that the patient is of Indian extraction and displays a marked interest in spiritualism. During his post-operative convalescence in hospital he put himself into a 'trance' on more than one occasion, and there is no doubt that he is highly introspective.

SUMMARY

The frequency, aetiology, associated conditons, diagnosis, and treatment of epiphrenic diverticulum are discussed.

A case is reported in which the diverticulum was successfully removed but dyspeptic symptoms persisted.

I wish to thank Dr. C. G. Whorlow for permission to reproduce the radiographs; Dr. Skelton for the pathological reports; and Mr. I. Joffe, my House surgeon, for his enthusiastic help in the management of the case recorded.

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FOREIGN BODY PERFORATIONS IN MECKEL'S DIVERTICULUM

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It is generally agreed that Meckel's diverticulum, the vestigial remains of the yolk-sac situated at the lower end of the ileum about 2 ft. from the ileocæcal valve, is found in only about 2 per cent of people, and so in itself is not common. Liability to complications such as inflammation, ulceration and hæmorrhage, intussusception and intestinal obstruction, are only occasionally encountered. Perforation as the final result of primary inflammation or of ulceration is sometimes met, but following the presence of a foreign body is of considerable rarity. Rossman in 1943 collected only 20 cases including his own, and since this date I can find none recorded. In only 5 of these cases was perforation caused by a foreign body other than a fish-bone, and in a review of the literature I have been able to find only 7 cases where a Meckel's diverticulum has been perforated by a foreign body other than a fish-bone. These include 3 cases of wood splinters, 2 of sewing needles, 1 of a gramophone needle, and 1 of rolled tomato peel. The following case is of considerable interest in that it is the first recorded one due to perforation by a cabbage stalk; this is remarkable in view of the frequency with which such food is ingested.

CASE REPORT

Female patient, M. W., aged 21 years was admitted to the Mid-Glamorgan County Hospital, Bridgend, on June 6, 1946, with a history of sudden generalized abdominal pain commencing at 12.15 p.m. on June 1. As she finished work at 12.30 p.m., she did not stop but carried on, the pain

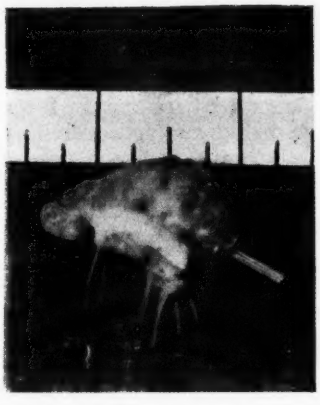


Fig. 459.—Colour photograph of specimen protruding from Meckel's diverticulum with inch rule for comparison. Inflammatory state of diverticulum is well illustrated.

gradually going. Later in the same afternoon about 2 p.m. she was having a bath when a recurrence of the pain took place, this time in the lower abdomen and of a more severe nature. It recurred at varying intervals throughout June 1 and 2, the family practitioner being first consulted on the night of June 1. There was some retching on the morning of June 1 and a rather loose motion, but no blood was passed—no medicine being taken. There was some burning pain on micturition on June 2 and 3, but no frequency or hæmaturia. Periods regular, 4/28; last period, May 21. No cough. No loss of weight. She had had one previous attack of upper abdominal pain lasting in all nearly nine weeks, twelve months previously, and diagnosed as 'indigestion'.

The patient's occupation is described as a sewing machinist. She apparently handles canvas and delivers it through an electric sewing machine, at the same time working the treadle of the machine, the whole idea being to sew piping on to the canvas which eventually is turned out as canvas chairs. She gives no history of putting the canvas to her mouth and is certain she has never swallowed any at any time. Further she has no recollection of having eaten anything out of the ordinary in the past few days. Her meals are taken entirely at home and she never eats canteen food.

On Admission.—Her general condition was good. T. 100° F., P. 96/min., R. 20/min. She was lying fairly still but did not appear to be in any great pain. Tongue was dry and furred. No abnormality detected in chest. There was some guarding and rigidity in both iliac fossæ,

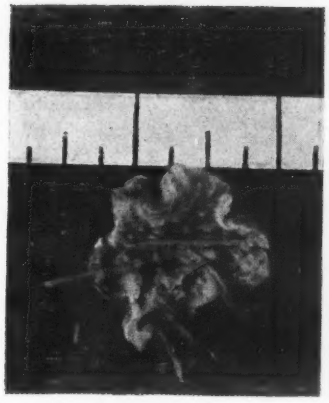


Fig. 460.—Colour photograph showing diverticulum opened. Specimen revealed in situ.

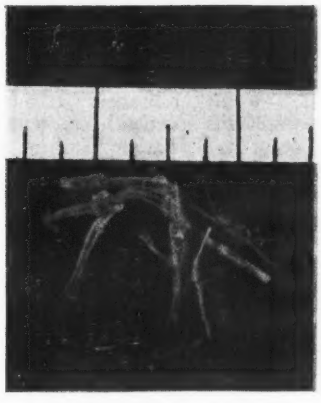


Fig. 461.—Colour photograph of specimen itself, following removal of diverticulum.

more marked in the right than the left. Pressure in the left iliac fossa elicited pain in the right iliac fossa (Rovsing's sign). Tenderness was most marked over McBurney's point and there was hyperæsthesia in the right iliac fossa. On rectal examination there was tenderness on the right side.

Operation (D. A. Macfarlane).—Undertaken almost immediately, with the presumptive diagnosis of acute

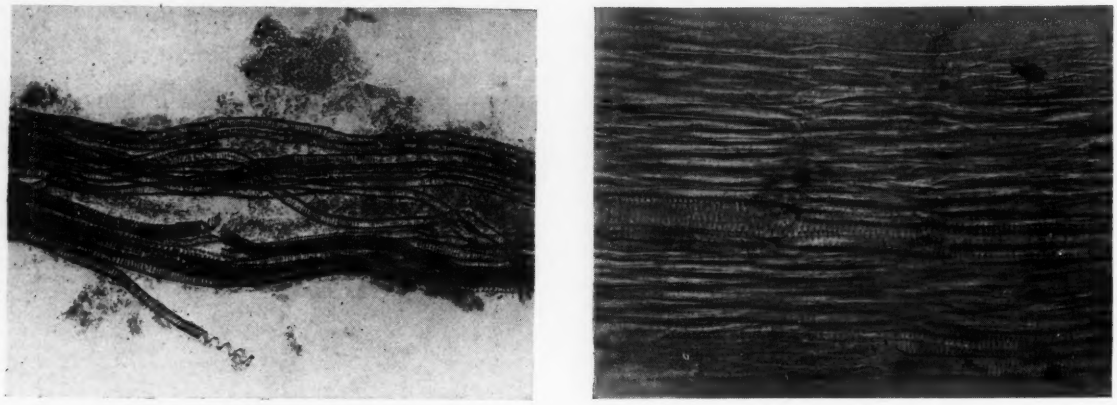
appendicitis. Lower right paramedian incision. Peritoneum opened and appendix located. Found to be elongated and bound down with numerous adhesions in the pelvic position, but not grossly inflamed. Removed. On tracing the small intestine upwards an inflamed Meckel's diverticulum was found 2 ft. from the ileocæcal valve. It was surrounded by two or three loops of small intestine which were localizing 2–3 oz. of thin inflammatory serous exudate. When the loops of the intestine were separated and the fluid removed, the Meckel's diverticulum was exposed; several strands of the foreign body were seen to be emerging from the apex and were floating free in the peritoneal cavity like the periscope of a submarine. The diverticulum, which was red, inflamed, and congested, was removed together with its contents and the ileum closed. Abdominal wall closed in layers without drainage.

Post-operative course normal. Allowed up on fourteenth day, with no complications.

THE SPECIMEN.—The specimen (cabbage stump) is best appreciated by inspection of the coloured illustrations. The first one (*Fig.* 459) shows the specimen as it was on removal, still lying inside the Meckel's diverticulum. The second one (*Fig.* 460) shows the specimen lying in the Meckel's diverticulum, the latter having been opened. The third one (*Fig.* 461) shows the specimen itself, which is straw-coloured and hard and has the consistency of a woody material. It measures nearly 2 in. long and possesses a central core with three or four branching processes. The diverticulum itself has the appearance of diffuse inflammation with a small perforation at its apex through which the specimen has protruded.

To determine, if possible, the exact nature of the specimen it was sent to the Department of Botany of the University of Wales at Cardiff, where an investigation and histological section were carried out, microphotography finally being performed.

Figs. 462 A, B, show the tissue at different magnifications. Professor R. C. McLean's report on the "vegetable tissue" submitted to him states that: "It is not possible to identify these fragments with any exactness, but I still adhere to my former opinion—on macroscopic examination—that they were probably part of a woody cabbage stalk. At any rate there is nothing in their appearance inconsistent with this view".



A B

FIG. 462.—Microphotograph of sectioned foreign body. A, × 66; B, × 120.

DISCUSSION

The superficial similarity of the appendix and a Meckel's diverticulum and the liability of similar complications in both structures makes one surprised at the relative infrequence of foreign-body perforations in the latter whilst its common occurrence in the former is so well known. That foreign bodies are found in Meckel's diverticulum without causing perforation is well illustrated by Miller (1927), who describes a case in which he found tomato and grape seeds and even an orange pip, the distal part being eventually converted into a cyst with finally strangulation of the small intestine. With those cases which have perforated, a review of the literature shows the great preponderance of fish-bones as the cause. In more recent years Webb (1933), Weinstein (1942), and Rossman (1943) all report cases. This makes Hiller and Bernhard's case (1933) of perforation by a rolled tomato peel somewhat unusual. Persson (1939), in reviewing the literature of foreign-body perforation in Meckel's diverticulum, quotes 2 cases of a wood splinter, as does also Berry (1927), together with 2 cases of part of a sewing needle and 1 of a gramophone needle. These, together with the present case, represent, as far as I can gather, the total literature on the subject, excluding the detailed discussion of the more common fish-bone.

With regard to the diagnosis, it appears to be almost impossible to differentiate the condition preoperatively from the perforated appendix unless there is some other pointing factor in the case such as melæna indicating an associated ulceration. All the cases reported, including the present one, were operated upon under the assumed diagnosis of acute appendicitis, though Persson maintains that when there is a history of a disturbed casting-off and healing of the umbilicus during the first few months of life, a Meckel's diverticulum might be suspected. This was not so in my case, but might be worth inquiring about, the natural difficulty being that few patients will be able to enlighten one on such a matter without having recourse to their parents—a significant handicap in eliciting a history in a middle-aged or elderly ill patient. A pre-operative diagnosis of a foreign body being present was made in the case of the sewing needles and also of the gramophone needle, but here again it could not be expected to be in a Meckel's diverticulum, and a routine radiograph was obviously carried out because of a history of ingestion of such a foreign body. In the average case a routine

radiograph of the abdomen would not therefore be of much help.

In view of the pre-operative diagnosis being an acute appendicitis it cannot be too often stressed that when the appendix is found to be normal or insufficiently inflamed to account for the symptoms, assiduous search for an inflamed Meckel's diverticulum should be made, and if the possibility of such is borne in mind then the disastrous calamity of leaving such an object behind will be avoided.

It appears to be generally agreed that the rarity of foreign bodies perforating a Meckel's diverticulum in contrast to an appendix is dependent on the wideness of the mouth of the former, which enables objects to float in and presumably float out again. In the appendix, once they have entered, reactionary œdema results in occlusion of the relatively narrow orifice, with subsequent perforation.

The commonness of the fish-bone being the main offender is easily explained by the frequency with which such objects are swallowed and by the structure of the bone itself, which by its spikes lends itself to embedding in the wall of the diverticulum, but the infrequency of a cabbage stalk as a cause of perforation gives rise to speculation. Persson, in an excellent review of the subject, discussed 2 cases in which he was convinced that the foreign body was a wood splinter, but on being sectioned and investigated by the Botanical Department both were found to be fish-bones. This, he maintains, might very well be the case in the other wood splinters described (Berry, Aschan), as there appears no record of their being investigated in this manner. This, however, need not necessarily be so, as in the present case the macroscopic appearance was akin to that of a wood splinter yet on further histological investigation proved to be a piece of cabbage stalk. The latter being much more often ingested than fish-bone, it would seem that cases recorded as wood-splinters might well have been cabbage stalk on further investigation. It would appear that the only prophylactic advice that can be suggested is the thorough mastication of all such food.

SUMMARY

A case of a Meckel's diverticulum perforated by a cabbage stalk is recorded. Perforations by foreign bodies are extremely rare, the majority being by fish-bones, and although no case of a cabbage-stalk perforation has been described before, it would appear that it may be more common than suggested if full investigation of all such foreign bodies were carried out.

My thanks are due to Dr. Jeffrey Jones, Medical Superintendent of the Mid-Glamorgan County Hospital, Bridgend, and to the Medical-Director-General of the Navy, for kind permission to publish this case; to Professor R. C. McLean, University College of South Wales and Monmouthshire, for his willing help and guidance in identifying the specimen and for the microphotographs; and to my friend and colleague, Mr. L. P. Thomas, for the photographs in colour of the diverticulum and its contents.

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CHRONIC THYROIDITIS: A CASE SHOWING FEATURES OF BOTH RIEDEL'S AND HASHIMOTO'S THYROIDITIS

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THE relation of the two diseases, Riedel's thyroiditis and Hashimoto's thyroiditis, has long been a matter for dispute. Some authors (Graham and McCullugh, 1931; Joll, 1939; McSwain and Moore, 1943) consider them to be distinct conditions on clinical and pathological grounds. Others (Shaw and Smith, 1925; Ewing, 1922; Vaux, 1938) present evidence that the two diseases are in fact early and late stages of one process, that the fibrous gland of Riedel's disease represents the final stage of the lymphoid goitre of Hashimoto. A few authors (Eisen, 1934, Means, 1937), are of the opinion that the two are related in some way, but consider the nature of this relation to be as yet unknown. Womack (1944) thinks it possible that they are different varieties of the same disease.

The facts and arguments on which each opinion is based are not reviewed in this paper, but the present state of the controversy may be well seen by contrasting two studies published a few years ago. Joll (1939) made it clear in his account of Hashimoto's disease that he regarded the condition as quite distinct from Riedel's disease. Vaux (1938), on the other hand, in a pathological study of 38 thyroid glands, mostly from Joll's cases, found examples illustrating successive stages in the disease process, starting from the lymphoid infiltration characteristic of Hashimoto's disease and leading to the fibrosis and atrophy of Riedel's disease.

The cause of these two diseases in man is unknown; the problem of their relationship, therefore, receives no help from the aetiological aspect.

On theoretical grounds, one might expect that decisive information would be obtained in cases of thyroiditis upon which two or more operations had been performed, or in which a post-mortem examination had been made some time after an operation. Material so obtained might demonstrate in the same

gland a change from the lymphoid type to the fibrous type; alternatively, it might show little change after an interval of some years. Though several such cases have been reported, the findings are often inconclusive, and do not permit of generalization (Perman and Wahlgren, 1927; Heyd, 1929; Roulet, 1931; Means, 1937; McClintock and Wright, 1937; Hellwig, 1938; Schilling, 1945); other cases have been reported without adequate clinical or pathological details.

Again, on theoretical grounds, if the two diseases are related, then occasionally one should see a gland showing characteristics of both diseases. Such a gland was found in the case reported here. It provides convincing evidence that the two conditions known as Hashimoto's and Riedel's thyroiditis can be present in the same gland at the same time. Moreover, the presence also of histological features intermediate between the two diseases strongly suggests that they are related in some way.

CASE REPORT

HISTORY.—A married woman aged 51 was admitted to University College Hospital under the care of Dr. K. E. Harris on Sept. 29, 1946. She complained of a swelling in the neck for three months. She had also disturbances of vision due to old iritis. There were no symptoms of recent or past thyrotoxicosis.

ON EXAMINATION.—The patient showed no signs of thyrotoxicosis or thyroid deficiency. The whole thyroid gland was moderately enlarged, smooth, and hard. The right lobe was rather more enlarged than the rest of the gland, and there was no demonstrable abnormal fixity to structures in the neck. Slight compression of the neck produced stridor. No enlarged glands were felt in the neck. X-ray examination showed lateral narrowing of the trachea and deviation to the left. B.M.R. + 10 per cent. Wassermann reaction negative.

A provisional diagnosis of carcinoma of the thyroid was made.

AT OPERATION.—The whole thyroid was removed at operation, by Mr. J. Taylor on Oct. 30. The findings were characteristic of those in chronic thyroiditis, and the condition was immediately recognized as such. The almost uniform hardness was confirmed. There were dense adhesions between the infrahyoid muscles and the anterior surface of the gland, particularly over the right lobe. There were also abnormally dense adhesions to the trachea. The left recurrent nerve and parathyroids were dissected off the gland and preserved. The right recurrent nerve was not seen.

PROGRESS.—The patient made a satisfactory recovery from the operation. When last seen on May 22, 1947, she was well. There was no recurrence of the goitre and no evidence of myxœdema.

THE SPECIMEN.—The excised gland weighed 53 g. and showed almost uniform enlargement, though the right lobe was bigger than the left. The surface was slightly nodular and anteriorly there were fragments of adherent infrahyoid muscles. The gland was hard and very tough to cut. Its cut surface was almost uniformly white and opaque, and had the appearance commonly seen when a mass of carcinoma is cut. In a few places there were small ill-defined areas of pale yellow or pink tissue. At the left upper pole there was a nodule about 1 cm. diameter which resembled solid thyroid tissue. There were no cysts or hæmorrhages.

HISTOLOGY.—Many sections were cut from various parts of the gland and were stained with Ehrlich's acid hæmatoxylin and eosin and with van Gieson's stain. Briefly the main mass of the thyroid, the white part, showed fibrosis and resembled the typical picture of Riedel's disease, while the yellow and pink areas showed marked lymphocytic infiltration and degeneration characteristic of Hashimoto's disease. The nodule was a small mass of hyperplastic thyroid tissue surrounded by a zone of lymphoid infiltration. The detailed histological findings are given in the description of the accompanying microphotographs. *Figs.* 463–465 illustrate the lymphoid infiltration and *Figs.* 466, 467 the fibrosis. An intermediate histological appearance is shown in *Fig.* 468.

A few giant cells of the foreign-body type were present, usually near the final remnants of acini. There was no evidence of endarteritis or of phlebitis.

DISCUSSION

The statement that both Riedel's and Hashimoto's thyroiditis are present in the case reported here is based on the pathological findings, for it is on such findings that the diagnosis of either type of chronic thyroiditis must ultimately be made; a gland showing destruction of thyroid tissue and dense, spreading fibrosis is called Riedel's disease, while a gland showing characteristic acinar degeneration and marked lymphoid infiltration is called Hashimoto's disease. It has been claimed, in addition, that cases of these diseases present certain distinctive clinical features, but from a study of recorded cases it is clear that there is a single broad clinical picture common to both, and attempts to draw a line between them have not been convincing. A much quoted table of differential diagnostic features compiled by Joll (1939) would appear to bear little relation to the facts recorded in actual published cases and the same may be said of similar tables compiled by Schilling (1945).*

A survey of published case records shows that both diseases occur over a wide range of ages, and authors are not agreed on the age of maximum incidence. Females are more often affected in both diseases, though the difference in sex incidence is rather more marked in Hashimoto's disease. Hypothyroidism occurs either spontaneously or after operation in a substantial proportion of both diseases. Either a part or the whole of the gland may be affected in both conditions, and if the whole gland is involved it may be irregularly affected. Both conditions may cause tracheal compression (often anteroposterior) and obstruction, and in both there may be adhesions to surrounding structures, though these are usually more striking in Riedel's disease. The gland is harder than usual in both conditions, and this again is often more marked in Riedel's disease, but it is common for a clinical diagnosis of cancer to be made in both diseases.

On clinical grounds, then, it is difficult to distinguish between the two diseases. Even when the diagnosis is supported by pathological findings, it seems likely that there are a considerable number of cases of an intermediate type. Thus Means (1937, Case No. 10824) describes a case in which the diagnosis was midway between Riedel's and Hashimoto's goitre; such a case he prefers to call chronic thyroiditis without further qualification. Schilling (1945, Case No. 5) describes a case which he finds so difficult to assign to one or other group

* Schilling, for example, states that struma lymphomatosa (Hashimoto's disease) occurs between the ages of 40 and 60. Of the 6 cases in his own series, the ages of 5 are given: 15, 27, 28, 30, and 52 years.

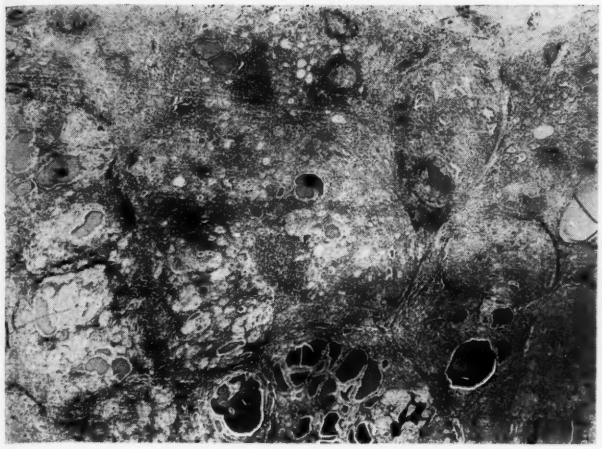

FIG. 463.—Shows infiltration and replacement of the thyroid tissue by lymphocytes, most of which are scattered diffusely throughout the section. There are also aggregates of lymphocytes, some of them forming germinal centres. The appearances are typical of Hashimoto's disease. (× 30.)

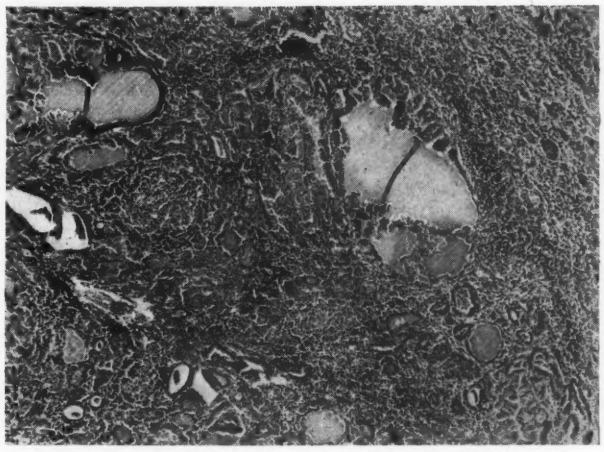

FIG. 464.—Shows diffuse infiltration with lymphocytes, and destruction of the smaller acini. There is almost complete absence of colloid and, typically, those acini devoid of colloid often contain what are usually described as desquamated acinar cells. (× 47·5.)

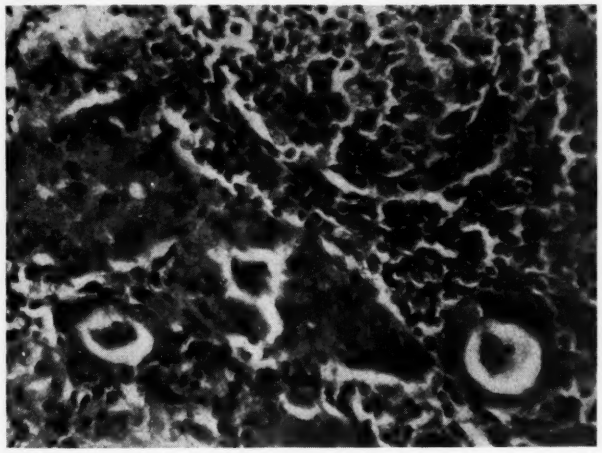

FIG. 465.—Shows the margin of a germinal centre of lymphoid tissue and desquamated cells in acini which are almost devoid of colloid. The cells in one acinus are pale and swollen, another feature often described in Hashimoto's disease. (× 240.)

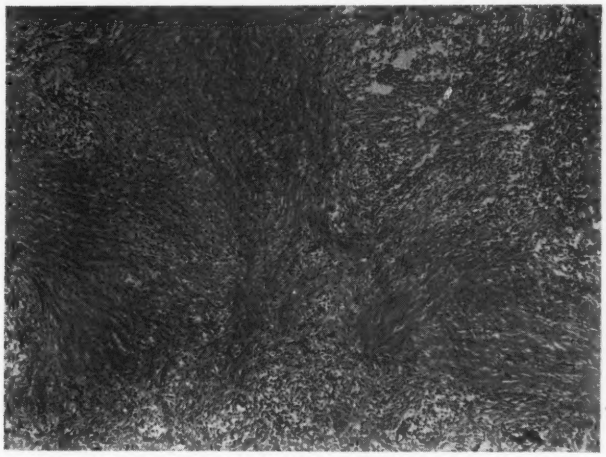

FIG. 466.—Illustrates the dense fibrosis present throughout the greater part of the gland. There is no sign of remaining thyroid tissue, though there are some lymphocytes and histiocytes. (× 47·5.)

FIG. 467.—Shows the spread of this fibrosis into adjacent bundles of infrahyoid muscles, producing the adhesions sometimes regarded as characteristic of Riedel's disease. The section illustrated here was taken from the outer surface of the left upper pole of the gland. (× 30.)

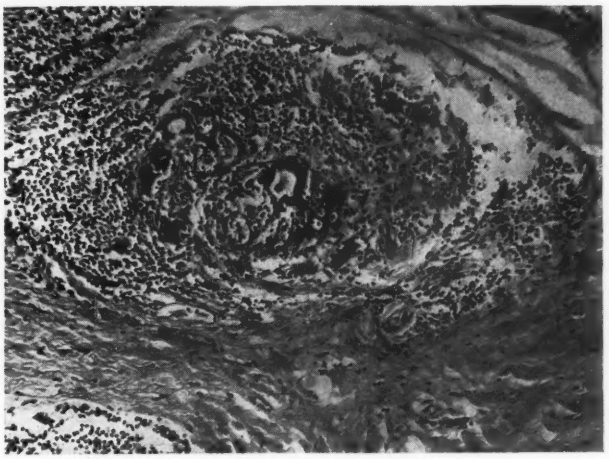

FIG. 468.—Shows almost complete destruction of a nodule of thyroid tissue. It is extensively infiltrated by lymphocytes and histocytes, and is surrounded and partly invaded by fibrous tissue. (× 100.)

that he calls it " an enigma ". The relative frequency of the two conditions in the collected series of different authors again suggests that cases occur which one author would call Hashimoto's and another would call Riedel's disease. The examples in the following table illustrate this.

Table I—SHOWING THE DIVERGENCE IN THE RELATIVE FREQUENCY OF HASHIMOTO'S AND RIEDEL'S DISEASE

	HASHIMOTO	RIEDEL
	No. of Cases	No. of Cases
Lee (1935)	26	90
McClintock and Wright (1937)	47	60
Joll (1939)	51	5 (or 10*)
Means (1937)	12	0

* It is not clear from Joll's paper which figure is correct.

These considerations, together with the findings in the case presented here, lend support to the attitude of Means (1937), and indicate that the two forms of chronic thyroiditis are related. It would seem reasonable, therefore, to describe both types simply as ' chronic thyroiditis ', and to qualify only extreme cases by the terms fibrous or lymphoid.

SUMMARY

1. A case of chronic thyroiditis is described presenting pathological characteristics of both Riedel's and Hashimoto's disease. The findings suggest that the two conditions are closely related.

2. A survey of previous writings shows that the two forms of chronic thyroiditis cannot be regarded as separate entities, either on clinical or pathological grounds.

I wish to thank Mr. Julian Taylor and Dr. Kenneth Harris for permission to report this case, and Dr. W. R. Trotter for valuable criticism.

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CARCINOMA IN A THORACIC STOMACH (CONGENITAL SHORT ŒSOPHAGUS)

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THE combination of congenital shortening of the œsophagus with partial intrathoracic stomach has been recognized with increasing frequency over the past fifteen years. Richard Bright is credited with having described the first case in 1836, but it was not till 1918 that the condition was rediscovered by Bund. Since then, radiologists and laryngologists have vied with one another to show that it is relatively common, though not always associated with symptoms.

The stomach is primarily a thoracic organ, and later descends into the abdomen. Following this, there is a fusion of the diaphragm except for the œsophageal hiatus. Should the stomach fail to descend normally, the œsophagus remains permanently shortened and a greater or lesser part of the stomach remains within the thorax. The œsophageal hiatus is large and lax.

Symptoms may arise in middle life. There is delay in the passage of food at the junction of œsophagus and fore-stomach causing low-grade œsophagitis with subsequent fibrosis and dysphagia. This closely simulates carcinoma, for there is marked loss of weight, substernal discomfort, and vomiting, sometimes with streaks of blood. Fortunately this condition is readily recognized by œsophagoscopy and responds well to the passage of bougies. True peptic ulceration also occurs in association with short œsophagus, and some writers have even suggested that ulceration rarely occurs apart from this condition. This is probably an overstatement, but it is generally accepted that the lax hiatus met with in these cases predisposes to regurgitation of acid into the œsophagus. In the past, peptic ulcers of the œsophagus have usually been attributed to islands of heterotopic gastric mucosa. Possibly the role of the thoracic stomach in accounting for some of this misplaced gastric mucosa has been underestimated.

Short œsophagus and carcinoma do not coexist frequently if case reports in the literature can be taken as a criterion. Previous to the recent paper by Waldron Smithers (1945) only 2 certain cases had been reported, one by Christiansen (1941), from Stockholm, and the other by Raven (1941). Smithers reported 2 more cases which had come under the observation of Sir Thomas Dunhill and refers in a footnote to Dr. A. S. Johnstone having seen 5 cases, though no details are given. Dr. Frank T. Land (1947) informs me that in reviewing the cases of short œsophagus seen at the Western Infirmary, Glasgow, over the past ten years, he had

found records of 2 cases in which carcinoma was associated. Raven's case was especially interesting from the surgical point of view, for radical removal of the growth was carried out, and though the patient did not survive, the feasibility of the operation from the technical standpoint was amply demonstrated.

The present case is reported, not on account of its rarity, but because it illustrates well the diagnostic pitfalls which may be met. Again the fact that the growth was removed permits discussion of one or two technical details in a branch of surgery which, though becoming standardized, still retains a growing margin.

CASE REPORT

Miss M. D., age 49, machinist, was admitted on March 27, 1946, to the medical wards of the Victoria Infirmary, Glasgow, under the care of Dr. Ian Murray.

For the previous eight months she had suffered from heartburn and pain in the lower left chest. The attacks of pain set in gradually, reached a maximum intensity in about 15 minutes, and died away within an hour. At first they came only once or twice weekly, but latterly the pain was present every day. There was no relationship to food or exertion. X-ray examination showed a hiatus hernia (*Fig.* 469), and as it was felt that this might explain her symptoms, operation was advised. Unfortunately no œsophagoscopic examination was carried out at this time.

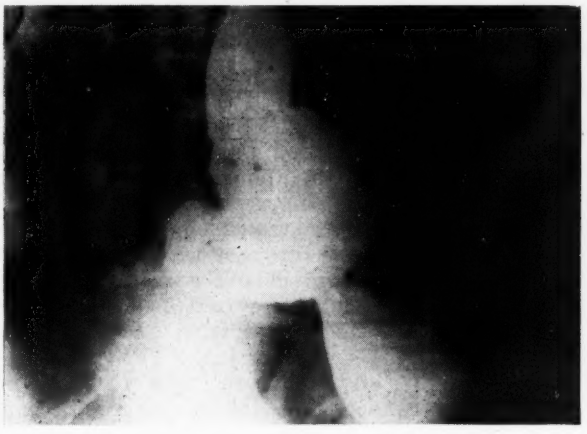

FIG. 469.—Radiograph taken before admission, showing hiatus hernia and short œsophagus.

FIRST OPERATION (April 16.)—A portion of the fundus of the stomach was found invaginated within a lax hiatus which admitted the tips of four fingers. The stomach was pulled down and the lax hiatus tightened by interrupted mattress sutures.

POST-OPERATIVE COURSE.—The patient appeared temporarily improved, but after two weeks there was a return of pain and later occasional vomiting. X-ray examination (*Fig.* 470) now revealed the condition of short œsophagus and an appearance of filling defect in the thoracic stomach. Œsophagoscopic examination was carried out on June 5 by Dr. T. O. Howie, who reported as follows: "Œsophagoscope passed easily to 31 cm. The gullet is atonic and sodden. A displaced cardia is encountered at 31 cm. from the upper teeth. On entering the forestomach a polypoid growth is encountered. A portion was sent for pathological examination. This patient suffers from a congenital short œsophagus. It is at least 6 cm. short of normal." The pathological report on the biopsy specimen was "poorly differentiated adenocarcinoma". Exploratory operation was advised. Sulphathiazole emulsion and oral penicillin were given for four or five days beforehand in an endeavour to cut down the bacterial content of the œsophagus above the growth.

SECOND OPERATION (June 28).—Under cyclopropane anæsthesia (Dr. R. N. Sinclair), an incision was made through the seventh interspace on the left side. On opening the pleura a growth was found involving the lowest 3 in. of the gullet. The mediastinal pleura was incised over the œsophagus just above the growth, and separation was carried out from above downward. The growth was firmly adherent to and involving the right mediastinal pleura, so that opening was unavoidable. The resulting pneumothorax caused great circulatory embarrassment. The growth was also adherent to and involving a portion of the lower lobe of the right lung. The involved portion of lung was ligated and removed. The opening in the opposite pleura was temporarily covered by a moist pack. The patient was kept going by controlled rəspiration.

FIG. 470.—Radiograph after operation for hiatus hernia. Showing filling defect in the thoracic stomach.

FIG. 471.—Radiograph after excision of carcinoma and œsophagogastric anastomosis.

The diaphragm was incised anteriorly and towards the left from the hiatus. Adhesions had formed between liver and diaphragm from the previous operation and these were separated. The growth was now thoroughly mobilized from above and below. An enlarged hard gland was found on the greater curvature near the spleen. The vasa brevia and left gastric arteries were ligated and the stomach mobilized sufficiently to allow its uppermost

part to reach as high as the root of the left lung. The fundus of the stomach was divided and the stomach closed. The conical fundus was now brought up and anastomosed to the œsophagus just below the root of the left lung and about 2 in. above the upper margin of the growth, using two rows of interrupted silk sutures. The technique employed was that for total gastrectomy, the œsophagus being opened a little at a time, the field being well packed off and suction employed to prevent soiling. It was possible to suture the edge of the mediastinal pleura to the stomach and cover over the line of anastomosis. The stomach was anchored to the thoracic wall and the diaphragm closed around the stomach.

It was noted that as soon as the stomach was brought up into the thorax it sealed off the gap in the right mediastinal pleura. The breathing improved immediately and the circulatory embarrassment disappeared. In view of the double pneumothorax it was thought inadvisable to crush the phrenic nerve. 600,000 units of penicillin were left in the left pleural cavity and the thorax was closed without drainage.

During the operation, which lasted over 3 hours, and during the first 24 hours following operation, the patient received 2 pints of blood, 1 pint of plasma, and 4 pints of glucose-saline. She had continuous oxygen administration for 8 hours following operation.

POST-OPERATIVE COURSE.—Rectal salines were substituted for intravenous fluids after the first 24 hours so as not to overload the circulation. Parenteral penicillin was continued for a week. Sips of water were given on the fifth day and whole milk on the seventh day. The left chest was aspirated 24 hours and 48 hours after operation, but only 1–2 oz. of serum were obtained. On the sixteenth post-operative day 20 oz. of serum were aspirated from the left chest. She was allowed up on the eighteenth day and went home on Aug. 23.

At the time of her dismissal she was taking a full diet, had no digestive discomfort, and fluoroscopy showed the anastomosis acting freely (*Fig.* 471). She gained weight and remained well for 10 months.

Recently (May 15, 1947) she has complained of some loss of weight and strength, suggestive of recurrence.

COMMENTARY

A case of carcinoma in a thoracic stomach is described, and though only 4 previous cases are mentioned in the literature, it is probable that the condition is more common. Tardy diagnosis and an unnecessary operation were the result of relying exclusively on X-ray examination, when œsophagoscopic examination would have yielded a more accurate picture. Admittedly the X-ray appearances were difficult to interpret, for there were three separate conditions present—first, a congenital short œsophagus, secondly, a carcinoma in the fore-stomach, and thirdly, a hiatus hernia due to cicatricial contraction of the malignant growth pulling still more of the cardia above the diaphragm. It is interesting in this regard to note that Harrington (1940), of the Mayo Clinic, describes short œsophagus as falling into two classes—first, the congenital type, and, secondly, the acquired type, the latter being due to carcinoma of the lower œsophagus pulling a portion of the cardia above the diaphragm.

From the operative standpoint the case is of interest because the patient survived a double pneumothorax. This in itself is not exceptional, but it does provide an opportunity to emphasize that double pneumothorax is the greatest single danger in œsophageal surgery, and that the problem of its management has not yet been solved satisfactorily. It is an unavoidable complication where the tumour is firmly adherent to the pleura of the opposite side, and repair of the pleura is not in my experience a practical proposition, at least not in large tears. Some surgeons refer almost casually to this complication as if it were of little moment and one easily treated by covering the gap with a moist pack. Certainly a pack will help, but in large tears, even with the assistance of controlled respiration, an enormous strain is placed on the circulation.

In the present case the gap in the opposite pleura could be perfectly sealed off by the stomach when it was brought up into the chest, but at least an hour or so elapsed between the time of the mishap and the stage of the operation at which this was possible. During this interval there was great circulatory embarrassment. It would appear that if the patient is not too old and his circulation is fairly resilient he will weather the storm, but if he is old and frail the complication will prove fatal. In a recent case of carcinoma of the lower œsophagus in a man of 66, the double pneumothorax caused a circulatory embarrassment from which he did not recover. A swab over the opening in the pleura and controlled respiration failed to relieve the blueness which developed and it was obvious that irreversible changes of circulatory failure were present.

Ivor Lewis (1946) in his recent paper has taken a more realistic view of this complication and rightly insists that it is the most serious danger which can arise in the course of an operation on the œsophagus. He suggests that the œsophagus should be separated all round but that the deep adherent portion should be left till the lower end of the œsophagus is divided. The œsophagus can then be lifted up from above and from below and the adherent part freed under vision. This is a valuable suggestion, but in future cases I would be inclined to go even further, and leaving for the time being the adherent portion of the œsophagus, would proceed to free, divide, and close the cardiac end of the stomach. Then not only could the adherent portion of œsophagus be freed under vision, but if a tear occurred it could be immediately plugged by the stomach drawn up into the thorax. This is a more effective and less dangerous seal than the damp gauze pack, which can make the gap larger if not used with care.

SUMMARY

1. A case is described of carcinoma in a thoracic stomach associated with a congenital short œsophagus.

2. It was removed by operation and continuity restored by œsophago-gastric anastomosis.

3. The complication of double pneumothorax is discussed and a suggestion made for its management.

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PARALARYNGEAL ACTINOMYCOSIS

REPORT OF AN EARLY CASE WITH SHORT REVIEW OF THE CONDITION

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ACTINOMYCOSIS anywhere in the body is by no means common, and the following case is worthy of report and comment, as it is an example of the disease at a very early stage, before the onset of any secondary infection, and appearing in one of the more rarely encountered sites of cervicofacial actinomycosis. It is encouraging, too, in that with early treatment complete eradication of the infection with minimum scarring was possible.

CASE REPORT

HISTORY.—A white male, aged 23 years, a joiner in civil life, an M.I. room orderly in the army, total army service 4½ years, service in India 1 year, complained of a lump in his neck. He first noticed the lump while shaving, in January, 1946. At that time it was the size of a sixpence in surface area.

He reported sick in the beginning of June, 1946. He was suffering no pain, but experienced a stretching sensation occasionally when shaving, and also when swallowing.

ON EXAMINATION.—There was a smooth, discrete, fusiform swelling, firm but elastic, 1–1½ in. long, and ½ in. across at the middle. The long axis was vertical, and the swelling lay in the right side of the neck alongside the trachea, overlapped anteriorly by the infrahyoid muscles; there was a suggestion of connexion between the muscles and the swelling, in that the anterior edge of the right infrahyoid muscles and the swelling moved together in a transverse direction, but there was no vertical movement. The upper limit of the tumour reached the lower border of the thyroid cartilage; the swelling did not move on swallowing; the skin over the tumour was not involved; no other glands or swellings were palpable in the neck; there was no evidence or history of inflammation.

General health good; no cough; no shortness of breath; appetite good; no abdominal complaints; no abnormality found on examination of the abdomen and chest. At no time did he have any pyrexia. Oral hygiene good. Radiography of the neck showed no abnormality.

The patient was seen by the E.N.T. specialist, who found the throat, nasopharynx, and larynx free from disease.

The patient was seen next on July 5. The maximum diameter of the swelling was now ¾–1 in., and the length 2 in. The discrete feeling of the lump had now gone, for upward and downward extensions were present; and the infrahyoid muscles were so involved that the swelling appeared to be in their anterior border. No fluctuation was found, the consistency being firm and elastic. The mass was not adherent to the trachea and did not move on swallowing; it was movable transversely but not vertically. Deeper structures did not appear to be adherent, and there was no pulsation of the mass, expansile or transmitted. There was no involvement of the skin, and no other swellings or glands were palpable in the neck. There were no other abnormal findings.

Blood sedimentation rate showed 7 mm. fall in the first hour (Westergren). X-ray examination of the chest showed no abnormality.

AT OPERATION.—It was decided to explore the lump, and this was done on July 10, 1946, through a collar incision at the level of the centre of the mass, i.e., 1 in. below the lower border of the thyroid cartilage. Skin-flaps were reflected up and down, with platysma; the muscle layers and fascial planes beneath were found to be converted into a mass of fibrous tissue. By blunt and sharp dissection entry was made into the deeper layers on the right side of the trachea, and an abscess cavity, of 2-c.c. capacity, was entered at the site of the original tumour. It was unilocular, and contained what appeared to be fluid, yellow pus. The abscess cavity was opened up, and the wall curretted and smeared with Bipp. The wound was then closed with a small wick drain down to the cavity.

The pus and curettings from the abscess were sent for culture and microscopy.

The wick drain was removed after 48 hours, and clips were removed on the third day. The wound was quite dry on the 11th day.

PATHOLOGY.—No organisms were grown from the pus, and no acid-fast bacilli were seen. Slides made from the curettings showed:

Granulation tissue with numerous blood-vessels and inflammatory infiltration. One granule was found, showing the branching mycelium of a streptothrix with a peripheral zone of club formation (*Fig.* 472).

FIG. 472.—Shows actinomycotic granules. The branching mycelium, surrounded by a peripheral zone of club formation, lies in granulation tissue. (× 75.)

SUBSEQUENT TREATMENT.—The patient was treated on receipt of the pathological diagnosis of actinomycosis with a total of 8,000,000 units of Penicillin I.M. in doses of 50,000 units 3-hourly from the twelfth post-operative day, and potassium iodide, gr. 20 t.d.s., for three weeks.

The patient is now, one year later, cured; the wound is almost invisible, and there is negligible residual thickening.

THE LITERATURE

Hoffmann (1906) added to the unusual sites of appearance of actinomycosis—that in relation to the larynx. In the first case he described there was sinus formation in the skin, and, on laryngoscopy, swelling and œdema of the arytenoid cartilage, aryepiglottic fold, and false cords on the side of the lesion. Later Hoffmann (1909) recorded 9 cases;

in this series, laryngeal involvement was not constantly found.

Beysiegle (1933) found in the literature 19 cases of actinomycosis of the larynx, with perichondritis; and he expressed the view that very few cases of actinomycosis of the neck that are related to the larynx are without evidence of perichondritis.

Vogel (1935), in a review of 14 cases, describes the only case of which I can find record, in addition to the above case, with neither involvement of the skin nor of the larynx.

In more recent years Daffas (1939) has described a case in which the swelling in the neck was first seen when the size of a nut, but even at that stage showed involvement of the right arytenoid cartilage, pyriform sinus, and aryepiglottic fold; this case proceded to involvement of the skin, with sinus formation. Vergues and Fabre (1942) describe a case in which both the larynx and the skin were involved.

Pathway of Infection.—The mode of entry of the organism to its final site in this case is not explained. In the literature, there are found expressed three views.

Hoffmann found constantly in his cases that there was an indurated band extending from the angle of the jaw to the upper end of the swelling in the neck. This band he considered to be the track along which infection entering through the lateral pharyngeal wall had travelled. In the case recorded above, no such band was noticed during examination.

Vogel was of the opinion that infection entered through the tonsils.

Schutz (1938) in his material could find no evidence of an entry point in the tonsils or nasopharynx, and concluded that the infection travels directly through the mucous membrane of the larynx or hypopharynx; but he found in his cases that the patient when first seen spoke hoarsely, and must therefore have been dealing with a late stage of the disease or with a condition not starting clinically in the soft tissues of the neck.

COMMENT

Paralaryngeal or parapharyngeal actinomycosis, which Cope (1938) differentiates into two types according to whether there is or is not accompanying perichronditis of the larynx, is a rare condition. Hoffmann and Vogel both found it to be more common on the left side of the neck. Fever is not a feature of the condition, nor is any lymph-gland involvement. There appears to be no relation to carious teeth.

The present case is of interest, not only because it was on the right side, but because it was seen in such an early stage that there was no involvement of the skin or larynx. With the rapid extension of the condition during the month it was first under observation, it is easy to imagine that the relatively more common picture with involvement of larynx or skin would soon have supervened.

Treatment.—The prognosis of actinomycosis in the region of the larynx, even before the days of chemotherapy, appears to have been favourable. Therapy with potassium iodide and with X rays was practised. I can find no previous record of treatment of the disease in this particular site by penicillin. But McCrae, Stevens, and Williams (1945) found that a total of 7,000,000 units of penicillin given in 4-hourly injections, over a period of fourteen days, was effective in cervicofacial actinomycosis, in which masses of actinomycotic granulation tissue with multiple sinus formation were present in relation to the angle of the jaw, supervening on the extraction of carious teeth, when smaller doses of penicillin and therapy with sulphadiazine had produced no lasting effect. Bohan and Serino (1945) cured a similar case following dental sepsis, with combined aspiration and penicillin; while Hamilton and Kirkpatrick (1945) record 2 such cases successfully treated, as did Hendrikson and Lehman (1945).

In this particular case surgery, potassium iodide, and penicillin together were effective. But as regards the effectiveness of the last-named I must add that it was not practicable to culture and determine the particular strain of actinomycosis present; and Garrod (1944) found by the metho l e used that the sensitivity of actinomyces to penicillin probably varied.

In conclusion I wish to thank Sir Cecil Wakeley for his very kind advice and criticism.

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SHORT NOTES OF RARE OR OBSCURE CASES

A CASE OF MIXED SALIVARY GLAND TUMOUR ARISING FROM ECTOPIC TISSUE

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So-called mixed parotid tumours are by no means rare but new growths arising from ectopic salivary gland tissue are fairly uncommon. Apart from this reason, the case is considered worth reporting on account of the size of the growth and of the great disfigurement which it produced. It will be seen from the photographs that the mouth was grossly distorted so that the angle on the left side came to lie nearly in the midline; in other words, the mouth was rotated almost through one right angle. The nose was pushed to the right and the vision of the left eye was seriously interfered with when looking straight ahead or to the left. It seems fairly clear from the photographs that the tumour was not connected with the parotid gland, and, further, the patient was very emphatic that the growth commenced on the cheek just above and to the left of the angle of the mouth.

CASE REPORT

History.—The patient, aged 74, was referred to the Radiotherapy Centre for treatment in October, 1946. She stated that a small lump had appeared on her left cheek near the angle of the mouth in 1899. It was removed in the same year by surgical excision. Some months or possibly years later the tumour recurred and very gradually increased in size. A second excision was performed when the growth was the size of a "small plum"; the patient thinks that the latter operation took place about thirty years ago. The growth again recurred and she decided that further operations were worthless as it was sure to appear again. The tumour gradually increased in size and she was referred for treatment only because she was homeless and had been admitted to a Council Infirmary, where the Medical Superintendent advised X-ray therapy.

On Examination.—A large swelling involved mainly the left side of the face (*Figs.* 473, 474). Some areas of the tumour were plum-coloured and others were paler. There was considerable venous enlargement over most parts of the tumour. Palpation revealed that some portions were quite soft and almost fluctuant whilst other areas were firm and hard. The skin was apparently attached in parts though not invaded and the mucous membrane of the cheek was pushed inwards by irregular outgrowths, but again this did not appear to be invaded by the growth. One area near the angle of the mouth was slightly ulcerated and bled a little during the examination. X-ray pictures did not show any evidence of calcification. There were no significant cervical lymph-glands.

After receiving one application of X rays a secondary hæmorrhage of arterial type took place and a day later a more serious one occurred. An opinion was now sought as to the question of surgical removal of the growth. It was considered that there was sufficient healthy skin at the edges of the tumour to cover the resulting defect in the cheek, if removal was accomplished. As the skin on the lips could be moved on the tumour, it was thought

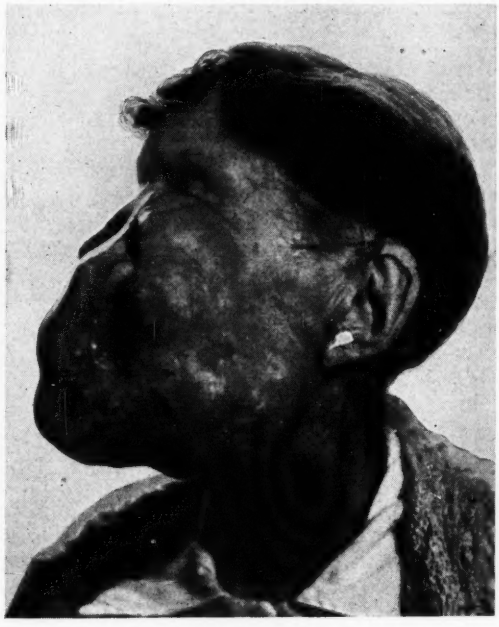

Fig. 473.—Showing the actual parotid-gland area to be free of growth.

Fig. 474.—Photograph showing the distortion of the mouth and nose and the interference with vision.

that this could be preserved and the growth shelled out. Operation was then decided on, the pre-operative diagnosis being mixed salivary gland tumour arising from ectopic tissue. The hæmoglobin before operation was 75 per cent. As serious hæmorrhage was expected, the operation was commenced with a blood-drip running and also a saline drip in another vein in case of a mishap with the blood transfusion.

OPERATION.—An incision was made in the left side of the neck and the external carotid artery isolated; a loop of tape was placed around the artery immediately above the bifurcation of the common carotid to help in the control of bleeding.

The facial incision was commenced in the region of the mouth preserving the red margin of the lip. This was extended up towards the nose and left eye and an attempt made to shell the tumour from the upper lip

FIG. 475.—The patient four weeks after operation.

and the adjacent areas. This was accomplished with little trouble. The incision was continued from the region of the left eye, down the cheek in front of the parotid gland, and around on the inferior aspect of the tumour towards the angle of the mouth. The whole tumour was shelled out of the facial tissues, but the much stretched mucous membrane of the cheek was sacrificed with the tumour. Care was taken to avoid the branches of the facial nerve passing to the orbicularis oculi. Stensen's duct, although looked for, was not definitely seen. Hæmorrhage was severe but was fairly easily controlled. Two pints of blood were given during the operation, which lasted one hour and twenty-five minutes. The skin-flaps were sutured without much difficulty in the manner shown in the photograph (*Fig.* 475).

PROGRESS.—The post-operative course was fairly uneventful and no sepsis appeared in the wound. Penicillin was administered for six days. Two weeks after the operation it became evident that a large firm adhesion had developed between the inside of the cheek and the upper gum on the left side. It was causing a certain amount of discomfort when eating. This was divided and the patient at once became much more comfortable.

THE SPECIMEN.—The report on the sections of the tumour is as follows: "This is a large solid tumour which histologically shows remarkable uniformity in structure. It is composed essentially of epithelial cells having an alveolar arrangement or being disposed in cords and columns. In places they are arranged in solid blocks, the peripheral cells being columnar and 'palisaded', not unlike the structure of a rodent ulcer or the solid type of adamantinoma.

"There is not a great deal of stroma present, and what there is, is for the most part hyaline in structure, and small columns of this material are interspersed between columns of cells giving a typical 'cylindromatous' appearance. In places it is possible to see the epithelial cells fading off and merging with the stroma, indicating that much of the hyaline material is derived from degeneration of the epithelial cells. Small areas of myxomatous degeneration can be found, but there is no formation of pseudo-cartilage or mucinous tissue.

"The cell type is very uniform, not unduly hyperchromatic, and no mitoses were seen, so that while the tumour is quite clearly locally malignant, its histological appearances suggest that it is probably not capable of metastasizing.

"In view of the history and structure of this tumour, a diagnosis of somewhat atypical 'mixed' salivary gland tumour may be made."

DISCUSSION

Barnard and Robb-Smith in *Kettle's Pathology of Tumours* state that the commonest tumour of salivary glands is the "mixed parotid tumour", but go on to point out that it also grows in the submaxillary gland, palate, and other situations. They also say that it was formerly considered to be an endothelioma, but it is now generally agreed that it is derived from epithelium, probably from the cells of the duct of the gland.

The recurrences after excision, the slow rate of growth, together with the site of commencement and the final position of the tumour, made the pre-operative diagnosis a reasonably certain one.

The patient when seen nine months after operation was very well and there was no evidence that the tumour was recurring. A plastic operation does not seem to be a justifiable procedure on account of her age. The orbital branches of the facial nerve supplying the orbicularis oculi had not been injured during the operation.

I am indebted to Dr. R. B. T. Baldwin, Pathologist to the War Memorial Hospital, Scunthorpe, for the histological report, and to Dr. James Z. Walker, Director of Radiotherapy, for asking me to see the case. I am also indebted to Dr. D. McQuillan and Mr. W. Roberts for the photographs.

A CASE OF TRAUMATIC STRICTURE OF THE COMMON BILE-DUCT

SUCCESSFUL CHOLEDOCHODUODENOSTOMY WITHOUT A TUBE

By J. SWIFT JOLY

LATE RESIDENT SURGICAL OFFICER, EAST HAM MEMORIAL HOSPITAL

BENIGN stricture of the common bile-duct is most commonly a sequela of cholecystectomy or other operations on the biliary organs. The case described here is of interest in that the stricture appears to have been a direct result of a rupture of the liver.

CASE REPORT

R. C., a lorry driver aged 47, was admitted to East Ham Memorial Hospital on April 24, 1946, having been crushed between two lorries. He was severely shocked and complaining of much pain in the abdomen and back. He was tender over the lower ribs on both sides and in the right subcostal area, and there was guarding all over the abdomen. No signs of free fluid were detected. Radiographs showed old fractures of 8th and 9th ribs and recent fractures of the right transverse processes of the 12th dorsal and 1st lumbar vertebræ. No bony injury to the pelvis was seen.

AT OPERATION.—Exploratory laparotomy was performed the same day by Mr. N. F. Morris, who was then Resident Surgical Officer. He found an extensive rupture of the liver in the region of the interlobar fissure and a rupture of the cystic duct, which was completely severed. No injury to the common bile-duct was detected. The liver was repaired with mattress sutures, cholecystectomy was performed, and the end of the cystic duct ligated. The spleen, stomach, duodenum, and intestines were uninjured. The abdomen was closed with a drain inserted down to the liver rupture.

PROGRESS.—The patient made a satisfactory recovery, and was discharged on June 5. I first saw him in the Out-patient Department two months later, and he appeared to be very well, but complained of a dull ache in the epigastrium and occasional sharp pains below the left costal margin. Later he began to notice that his urine was sometimes dark, and three months after the injury he became jaundiced. He was re-admitted for investigation on Sept. 19. There were no physical signs except the jaundice and epigastric tenderness. Van den Bergh's reaction on Sept. 23 showed a prompt darkening in the direct test to cherry red, maximum intensity being reached in ten minutes. The indirect quantitative test showed 16 v.d.b. units or 8 mg. of bilirubin per 100 c.c. Bile was constantly present in the urine, and the fæces were usually clay-coloured. He never complained of any itching. The jaundice fluctuated in intensity during the next few weeks, and on Oct. 1 the Van den Bergh test was weaker, being 6 units or 3 mg. bilirubin per 100 c.c., but the skin colour gradually deepened, and it was decided to perform an exploratory laparotomy.

SECOND OPERATION (Oct. 22).—This was performed by Mr. S. I. Levy under gas–oxygen and cyclopropane anæsthesia (Dr. Marsden). Right oblique subcostal incision. The stomach, duodenum, and liver were found to be bound to the anterior abdominal wall by dense adhesions which had to be divided with the knife. The duodenum was firmly adherent to the under-surface of the liver and was freed with great difficulty. The common bile-duct was found to be dilated as far as the stump of the cystic duct and then abruptly narrowed to a fibrous cord. It was opened and the lower end found to be completely stenosed. An incision was made in the first part of the duodenum, and the bile-duct anastomosed to it by end-to-side technique without using any supporting tube. The wound was closed with a drainage tube.

In the forty-eight hours following operation gastric suction produced large quantities of dark-green fluid, while bile was also discharged from the drainage tube. The jaundice began to fade immediately, and the fæces slowly began to regain normal colour. A discharge of bile from the drainage tube for over a week caused some anxiety as to the success of the anastomosis, but the presence of bile in the stomach and intestine was reassuring and the fistula soon healed. He was discharged on Nov. 20.

DISCUSSION

A survey of the literature shows that a vast majority of benign strictures are sequelæ of cholecystectomy or some other operation on the gall-bladder or bile-ducts. Flickinger and Masson (1946) give a table of 188 patients at the Mayo Clinic, of whom only 2 had had no previous operation. A large proportion had undergone multiple operations—in fact the group of 188 patients had undergone collectively a total of 278 biliary operations. Other causes mentioned in the literature are ulceration of the common duct from impacted gall-stones and chronic cholangitis. Surgical trauma is therefore by far the commonest cause of stricture. The most likely way in which it may occur is by traction on the cystic duct pulling the normal T junction out into a Y so that the clamp is placed across both limbs of the common duct. Or the clamp may be placed so close to the wall of the common duct that it constricts it. A third cause is when an artery forceps is plunged into a bloody field after the cystic artery has been torn, and the bile-duct is included in the grip. It is unlikely that the case under review can be attributed to such faults of technique, for the dilated portion of the common bile-duct extended down as far as the stump of the cystic duct and just below it, and thereafter became a fibrous cord as far as could be traced. It seems likely, therefore, that the cause of the stricture was a dense fibrosis which matted all the organs together, doubtless due to the escape of bile and blood into the peritoneum. It is possible, too, that there had been a reflux of activated pancreatic juice up to the common bile-duct. Whipple (1938) has described 3 similar cases.

Various ingenious techniques have been devised for the repair of strictures in the common bile-duct Warren H. Cole (1946) divides them into four major groups: (1) Local strictures which can be resected with primary anastomosis: (2) Stricture of the terminal end only, allowing transplantation into the stomach or duodenum; (3) Stricture of the proximal portion, allowing preservation of the sphincter of Oddi; (4) Destruction of the whole duct.

In group 1 Cole recommends that the anastomosis be done over a rubber or vitallium tube. If a T-tube is used it should be brought out through

an incision in the duct distal to the repair line. For group 2 the method of choice is choledochoduodenostomy, done either without a tube, as in the case described, or over a flanged vitallium tube of the type devised by Pearse. In groups 3 and 4 it is necessary to anastomose the duodenum or jejunum to the hilum of the liver. If no hepatic duct is visible on the surface, the liver must be incised until a dilated duct is discovered. Anastomosis must be performed over a tube of rubber or vitallium to serve as a scaffold for repair to take place. According to Colp (1938), the tube is usually passed per rectum after three to twelve weeks, but cases are known of its retention after eight years.

One objection to hepaticoduodenostomy is the risk of attacks of ascending cholangitis. For this reason many surgeons prefer to use a defunctionalized loop of intestine or the arm of a Roux's Y-anastomosis. Cole and Whipple also recommend the construction of intraluminal valves in the defunctionalized arm.

SUMMARY

A case of stricture of the common bile-duct following ruptured liver is described. The treatment was choledochoduodenostomy without a tube. The aetiology of traumatic strictures and the principles of their treatment are discussed.

I am greatly indebted to Mr. S. I. Levy for permission to publish this case, and for many helpful suggestions received.

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ADENOMATOUS APPENDICULAR POLYP CAUSING INTUSSUSCEPTION

BY A. CLIFFORD BREWER, LIVERPOOL, AND R. MARCUS, LIVERPOOL

FIVE cases have previously been reported of appendicular intussusception due to the presence of a polypoid mass near the appendix base (Wright and Renshaw, 1897; Burghard, 1914; Blaxland, 1920; Szenes, 1922).

The condition is thus considered to be of sufficient rarity to report the following case, particularly as the specimen obtained was of such perfection.

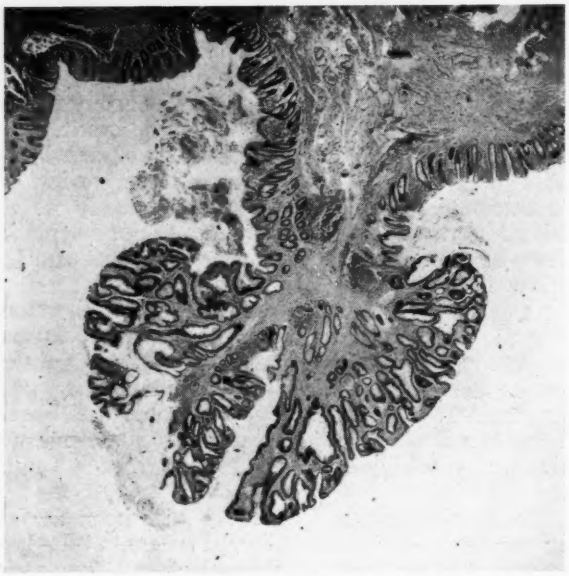

FIG. 476.—Simple adenomatous polyp of appendix base (low-power view).

CASE REPORT

A female patient, aged 34 years, was admitted to hospital with severe central abdominal pain of some 6 hours' duration. Pain had also occurred during the last 2 hours 'down the right side'. There was nausea, but no vomiting. Abdominal examination showed normal respiratory movement, no rigidity, tenderness present in the right iliac fossa and periumbilical region, and a band of hyperæsthesia about 1 in. wide across the abdomen just below the umbilicus. A diagnosis of early acute appendicitis was made.

At operation the appendix tip was seen just protruding from the cæcum. Gentle traction with forceps delivered the appendix out of the cæcum. The appendix, some 4 in. in length, was congested and swollen. The patient had an uneventful convalescence.

On opening the appendix a rounded pedunculated tumour was found some 2 cm. from the appendix base. Section of this tumour showed a simple adenoma with some congestion and cellular infiltration (*Fig.* 476).

COMMENT

Active appendicular peristalsis has long been known to occur and may be demonstrated *ex vitro* (Gunn and Whitelocke, 1914). Many 'foreign bodies' may initiate intussusception, such as worms (McSwain, 1941), the appendiculocæcal sphincter (McDermott, 1931), simple inflammation of the base (McLennan, 1919), or, more commonly, concretions (Fraser, 1943). It is indeed strange that, with the large number of concretions found in the appendix, intussusception is so rare.

Diagnosis is usually made at operation, although radiographic examination has proved of some help in certain cases (Skarby, 1941; Hall, 1934).

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AN UNUSUAL CASE OF MULTIPLE MALIGNANCY

By E. D. GAGNON, Toronto

Multiple primary tumours are no longer considered a rarity. Slaughter (1944) in a review of the literature collected 1868 such cases. Of these, 54 per cent occurred in a single organ or in each of paired organs. Many more reports have found their way into medical journals in the past three years. Some are doubtful, others interesting, and a few unusual.

The autopsy records of the Toronto General Hospital show a total of 31 cases in the past ten years. Though the series is infinitely smaller than Slaughter's collected cases only 16 per cent occurred in a single organ, and no case was found in each of paired organs.

Sixteen of our cases were consecutive, in that a second primary occurred after cure of the first, the intervening period being on occasion prolonged.

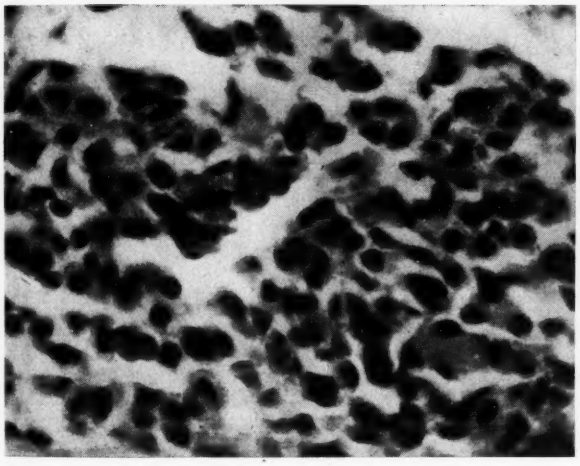

Fig. 477.—Seminoma of testis. (×600.)

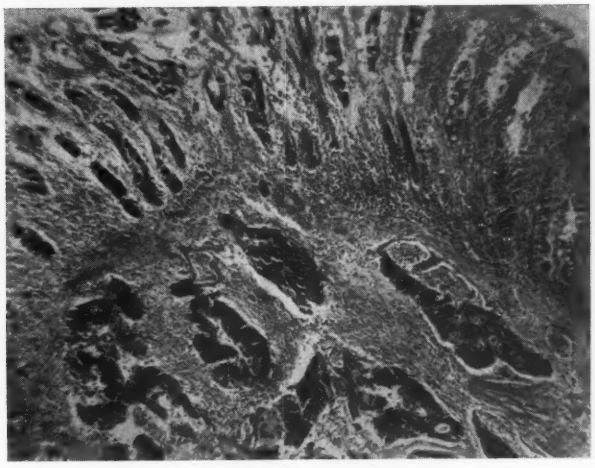

Fig. 478.—Adenocarcinoma of cæcum. (× 48.)

The most striking example of this was a recent case where a man, cured of six different skin cancers, became a victim of bronchogenic carcinoma. The other 15 cases showed coexistent lesions and in some the secondaries of both were present in one organ, i.e., the liver. Such is the case reported herewith.

CASE REPORT

W. R., a 71-year-old man, had been in ill health for two and a half years. The onset of his troubles was marked by vague crampy abdominal pains, progressing gradually to nausea, vomiting, and signs of intestinal obstruction. In another hospital a barium enema revealed obstruction at the hepatic flexure and a "suspicious irregularity" in this area. At laparotomy multiple adhesions binding down the terminal ileum were freed. No growth could be palpated in the colon. The patient recovered, and on discharge it was believed that the adhesions had been the result of an appendicectomy twenty-three years previously.

A second attack of partial small-bowel obstruction occurred one year later and cleared up on conservative management. Four and a half months before death he was seized by a severe dizzy spell while at rest, immediately followed by a massive tarry stool. After this incident he became gradually weaker and paler; diarrhœa and constipation alternated, and tarry stools were noticed on several occasions. Increasing abdominal girth over a period of three weeks finally forced his admission to hospital.

Examination showed him to be extremely pale (Hb, 30 per cent). About 1600 c.c. of greenish non-turbid fluid were removed from the abdomen. This fluid was negative to bile and urobilin tests, and no malignant cells were found in the sediment. A large fixed mass could be palpated in the right lower abdomen and followed the course of the ascending colon. Stool examination was positive for blood. A barium enema confirmed the clinical diagnosis of carcinoma of the right colon. One week before death frequent tarry stools occurred and persisted until the fatal outcome.

Post-mortem Findings.—Autopsy revealed a large (9 × 10 × 6 cm.) infiltrating tumour occupying the cæcum and ascending colon as far as the hepatic flexure. Extensive secondary tumours studded the peritoneum and both diaphragms. Many loops of small bowel, in conjunction with matted omentum and mesentery, were firmly adherent to the main mass; 1000 c.c. of greyish, murky, ascitic fluid and 300 c.c. of slightly bloody pleural fluid were present. Section of the ascending colon and cæcum revealed an infiltrating mass occupying the medial wall of the bowel. Scattered small ulcers occupied the mucosal surface and the lumen was obstructed in its upper third.

Many secondary growths were scattered throughout the liver, and the larger ones were umbilicated. The portal vein was distended and blocked by tumour tissue.

The right testicle was hard and enlarged to one and a half times (6·5 × 4·5 × 5·5 cm.) the size of its normal mate. The cut surface was greyish-white and very firm, the non-adherent surrounding tunics falling away easily. Further findings were pedunculated polyps (1 cm. in diameter) in the stomach.

Microscopical examination of the sections was surprising. The testicular tumour was a typical seminoma (*Fig.* 477). The secondaries of peritoneum, falciform ligament, and some of the mesenteric glands were made up of unmistakable seminoma cells.

The large mass in the cæcum, on the other hand, was a typical adenocarcinoma (*Fig.* 478). Of even greater interest was the presence of seminoma cells in

distended lymphatics of this carcinomatous cæcum (*Fig.* 479). The portal vein and some mesenteric lymph-nodes were full of adenocarcinoma.

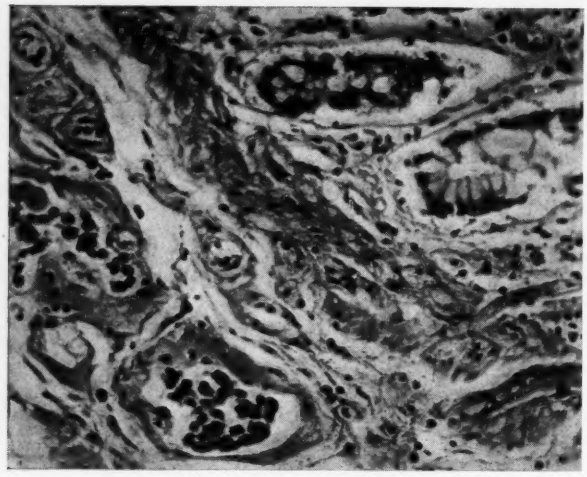

FIG. 479.—Seminoma cells in lymphatics of cæcum (*left*); adenocarcinoma (*right*). (× 225.)

Some of the liver secondaries were seminoma and others adenocarcinoma. The benign nature of the gastric polyps was confirmed microscopically.

The striking feature of this case is not the multiple malignancy, but the intermingling of the tumours. It is indeed unusual to encounter metastatic growths in the liver derived from two entirely separate and distinct primary sources. Moreover, seminoma cells (secondary) were found in the primary carcinoma of the cæcum. It is possible that these may represent the source of the nodules of seminoma in the liver, but it appears more reasonable to suppose that spread was by way of the lymphatics in the peritoneum and falciform ligament.

SUMMARY

1. An unusual case of seminoma of the testicle coexisting with a large adenocarcinoma of the ascending colon has been presented.

2. Extensive involvement by seminoma of peritoneum, omentum, mesenteric lymph-nodes, cæcum, and liver was seen.

3. Metastases from the adenocarcinoma were found in mesenteric glands, portal vein, and liver.

4. The liver invasion by seminoma is discussed.

5. The autopsy records of the Toronto General Hospital reveal 31 cases of multiple malignancies in the last ten years.

Grateful acknowledgement is made to Professor William Boyd for help and advice in the preparation of this paper.

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LARGE ANGIO-ENDOTHELIOMA OF BUTTOCK

BY M. R. EWING

VASCULAR tumours originating in muscle planes appear to be sufficiently uncommon to warrant placing the following case on record.

CASE REPORT

The patient, Mrs. E. G., aged 61, was admitted to hospital on Aug. 17, 1946. Sometime in 1944 she first noticed the presence of a painless swelling in the right buttock. This she attributed to an injury about three years previously when she fell from a tram, landing heavily on her right hip. This was not followed by bruising and crippled her for a few days only. The swelling continued to increase slowly in size, but its enlargement had been considerably more rapid during the few months immediately prior to admission. It had become, in consequence, a source of great inconvenience, so that she was unable comfortably to instal herself in even a soft chair. She had a variety of other symptoms, none of which seemed, however, to have any obvious relation to the tumour of the buttock.

ON EXAMINATION.—She was found to be a thin and frail old lady. There was no clinical evidence of anæmia, but there was a harsh systolic murmur at the apex and many extrasystoles.

In the right gluteal region (*Fig.* 480) was a large tumour the size of a pine-apple. The overlying skin was stretched, but not tightly so, and could be moved readily across the uniform surface of the tumour. There was a very obvious varicosity of the superficial veins, but this was not confined to the skin over the tumour and was in fact more obvious on the posterior aspect of each thigh and in the calf.

The growth was firm and not in the least tender. In no area could fluctuation be elicited. It did not pulsate and no thrill could be detected. Although deeply placed it could be moved a little from side to side and one had the impression that it was encapsulated and simple, rather than infiltrating and malignant. Active contraction of the glutei did, however, anchor the tumour more completely and made definition of its margins less easy. There was no clinical evidence of involvement of the sciatic nerve. X-ray examination of the pelvis was negative. The provisional diagnosis of an intermuscular lipoma was made.

AT OPERATION.—On Aug. 21, 1946, under general anæsthesia the tumour was explored through a generous oblique incision in the line of the upper fibres of the gluteus maximus. In the absence of much subcutaneous fat the tumour was almost immediately encountered, covered by the stretched and attenuated fibres of the gluteal muscles. It was found to be an obviously encapsulated growth from which the overlying structures could readily be stripped. Dissection, however, became increasingly difficult owing to the presence of numerous distended vessels. They were so fragile as to bleed on even the gentlest manipulation and efforts to underpin them in turn with an aneurysm needle seemed to lead only to puncture of the adjacent veins and to more alarming hæmorrhage. What had begun as an easy dissection soon became a hazardous and bloody operation. New tissue planes were explored in an attempt to avoid tearing the vein radicles, but without success. There was now clinical evidence of peripheral vascular failure, so the bleeding was temporarily staunched by pressure over a large pack while a blood transfusion was set up. It now seemed obvious that the bleeding would not readily be stopped while the tumour was still present, and working as quickly as one could it was at last roughly enucleated from a pool of venous blood which welled

up quickly and unceasingly into a wound already surrounded by a palisade of forceps and where anatomical landmarks had long since been lost. The bleeding was now arrested without much difficulty, and fortified by

FIG. 480.—Showing appearance of tumour in the right buttock.

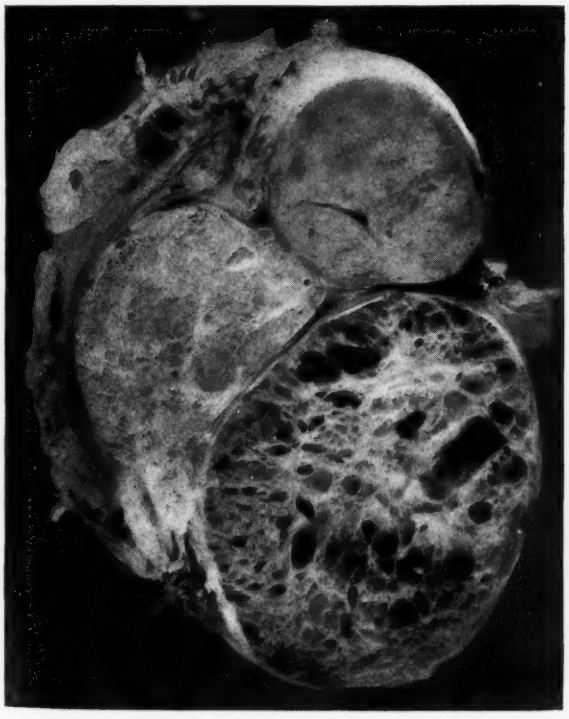

FIG. 481.—The cut surface of the tumour after fixation, showing the different naked-eye structure in the three main lobules.

1 pint of plasma and 2 pints of blood before she left the theatre, her general condition was somewhat improved.

THE SPECIMEN.—The pathologist (Dr. Adler) reported on the tumour as follows: —

"Smooth-walled tumour with tendinous surface; largely cystic. Measures 120 × 110 × 100 mm. (*Fig.* 481).

"Section shows that the larger area is formed by a cystic tumour consisting of innumerable cysts, 3–12 mm. in diameter. Two other areas are solid. They are both well defined and not attached to the actual capsule.

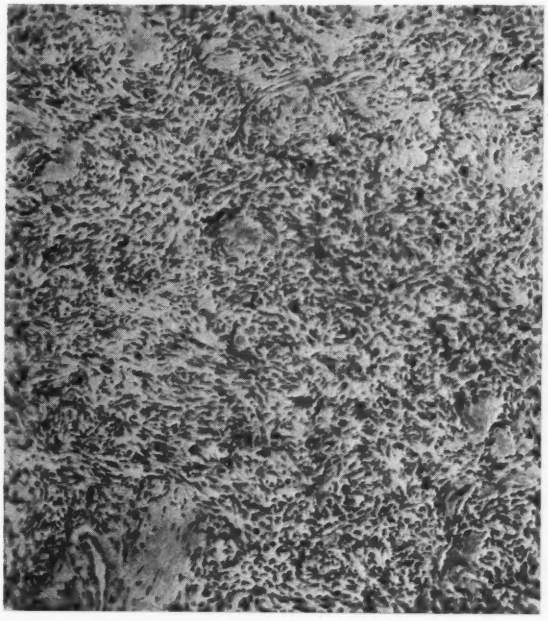

FIG. 482.—Showing the richly cellular character of the tumour. (H. and E.) (× 80.)

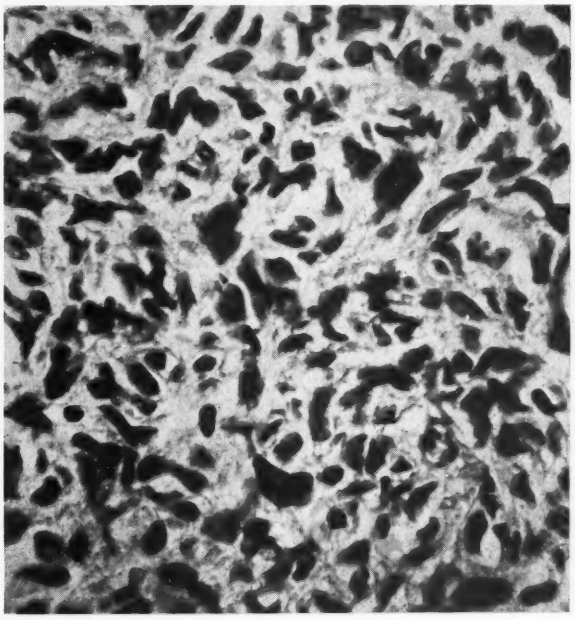

FIG. 483.—High-power view. (H. and E.) (× 475.)

One of them is devoid of any structure and the other one shows a lobular structure with whitish strands of intervening tissue. At one area, large blood-vessels are seen to enter the tumour.

"The histological picture (*Figs.* 482, 483) is that of an active and partly very cellular angio-endothelioma. The tumour is formed by blood channels which are immediately surrounded by a varying and sometimes considerable thickness of cells. These cells are spindle-shaped or elongated and, although numerous, are devoid

of signs of frank malignancy. Mitoses are rare. Very few of these blood channels have an actual vascular wall and few, if any, have an outer adventitial coat. The tumour is very active but seems to have been completely removed.

"Conclusions: Cellular angio-endothelioma."

PROGRESS.—Convalescence was delayed by a low-grade infection of the drainage track which was treated with penicillin. She was discharged from hospital on Oct. 8 and when last seen about two months later was fit and well (*Fig.* 484).

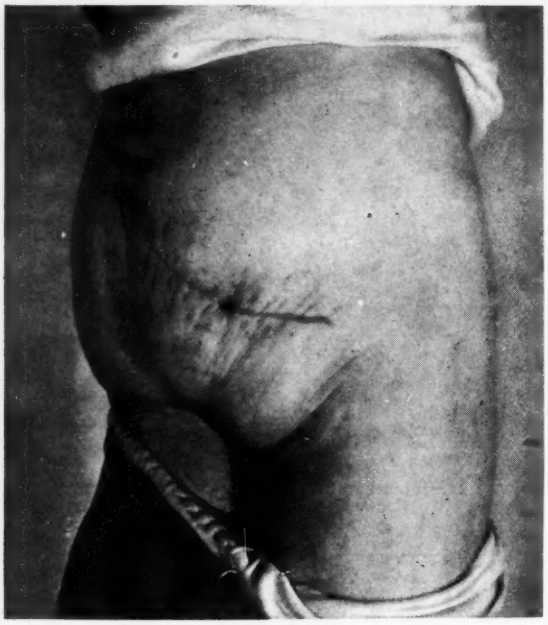

FIG. 484.—Showing redundant skin over the buttock after operation.

DISCUSSION

Extensive reviews of hæmangiomata of muscle have appeared from time to time, notably by Davis and Kitlowski (1930) and Jenkins and Delaney (1932). The most recent and the most complete is that of Shallow, Eger, and Wagner (1944), who have collected and analysed all the cases in the available literature—335 in number, of which 11 occurred in the gluteal region. The tumour in most instances has fairly definite clinical features and this diagnosis must be borne in mind when confronted with a puzzling lump in muscle. It occurs most frequently in the lower limb, the quadriceps being the commonest site. Characteristically it presents itself as a lump which grows slowly over a period of years, and eventually becomes both painful and disabling. Occasionally there is suggestive bluish discoloration of the overlying skin or a warning telangiectasis, but considering the extreme vascularity of the tumour, the presence of pulsation or of a thrill or bruit is noted with surprising infrequency. It varies in density from soft and pseudo-fluctuant to very firm or almost hard, and it may even be possible to empty one in part by pressure or at least to reduce it in size by gravity drainage.

A correct pre-operative diagnosis was made in only 19 per cent of cases, most, as in this instance, being thought to be lipomata. Exploration of the tumour with an aspirating needle may help if blood is readily obtained, and the presence of phleboliths in a soft-tissue radiograph might also suggest the correct diagnosis. In the future angiography will no doubt be carried out more frequently. The lump in a high proportion of cases (17 per cent—Shallow and others, 1944) appears to follow trauma. The condition should always be kept in mind when confronted by a patient, especially if he is under the age of 30, who gives a history of the development of a slowly-growing tumour in muscle following an injury.

At operation the tumour may happily be found to be circumscribed and readily enucleated, but in the majority it is wholly or partially diffusely infiltrating, so that surrounding involved muscle must be excised. The only hazard of the operation is the control of bleeding. Even after preliminary temporary ligation of the common iliac artery, the removal of one gluteal hæmangioma (Shallow and others, 1944) involved an operation of three hours' duration, during which 80 tubes of catgut were used.

The gross pathological picture is variable and as seen under the microscope the cell picture may range from areas which consist of aggregations of cavernous blood spaces to others which are almost completely cellular so that vascular channels are few and far between. It is to tumours of this type that the term angio-endothelioma is applied.

Although the infiltrating characteristics of the diffuse type suggest potential malignancy, metastases occur in less than 1 per cent of cases (Geschickter and Keasbey, 1935).

They are probably congenital tumours, due primarily to an incomplete maturation of some of the elements in the developing vascular tree, with trauma playing only a secondary role in precipitating more rapid growth and the development of symptoms.

Surgical removal is the procedure of choice and the results of such treatment are as a rule completely satisfactory, although local recurrence may follow incomplete removal. If the tumour is for any reason deemed irremovable or if it has in fact been only partially excised or the histology is suggestive of malignancy, a course of X-ray therapy seems to be worth considering.

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ENDOTHELIOMA OF THE STOMACH CAUSING ACUTE RETENTION OF URINE

By A. N. GUTHKELCH

LATELY RESIDENT SURGICAL OFFICER, MANCHESTER ROYAL INFIRMARY

THE following case presents unique clinical and unusual pathological features.

CASE REPORT

M.L., aged 29, a house-painter, presented himself in the accident room of the Manchester Royal Infirmary on Jan. 18, 1943, complaining of inability to pass urine. He stated that he had suffered for one month from incontinence of micturition with dysuria and scalding. On the morning of admission he had felt a strong desire to pass urine but none came away despite several attempts. He had no other complaints. His appetite was good and his bowels regular. There was no history of venereal infection. He had not noticed any abdominal swelling.

ON EXAMINATION.—The patient was a healthy looking young man, and it was remarkable that though he seemed slightly uncomfortable he was by no means in the extreme pain usually associated with acute retention of urine in a young adult. His tongue was clean and moist and the mucous membranes of normal colour. There was a tense, regular, somewhat pear-shaped swelling rising from the pelvis to about 1 in. above the umbilicus. It was dull on percussion, tender, and immobile. Pressure upon it gave rise to an intense desire to micturate. Rectal examination showed a firm regular swelling above the prostate over which the rectal mucous membrane moved freely. The prostate and vesicles were normal. No abnormality was found elsewhere.

A soft rubber catheter passed easily into the bladder but only a few drops of heavily blood-stained urine were withdrawn. Examination was repeated with a gum-elastic catheter with a similar result. At this stage the most likely diagnosis appeared to be one of rapidly growing tumour of the bladder, possibly a sarcoma, and the patient was therefore prepared for operation.

AT OPERATION.—Under general anæsthesia a right paramedian subumbilical incision was made. It was seen at once that the peritoneum came down anteriorly to within an inch of the symphysis pubis and that the bladder below it was neither engorged nor tense. This seemed to exclude the possibility of an intravesical tumour.

Accordingly the peritoneum was opened. The tumour proved to be a large, firm, yellowish mass, with some cystic and a few hæmorrhagic areas on its surface (*Fig.* 485), growing between the layers of the great omentum and firmly attached for about 2 in. to the greater curve of the stomach. Inferiorly it had no attachments, but was impacted in the pelvis, from which it was delivered without undue difficulty. This done, a few tiny transparent cysts were seen scattered over the remainder of the great omentum and in the pouch of Douglas. The liver and regional lymph-glands were normal.

A local resection of the mass, together with a generous cuff of stomach wall, was performed and the stomach sutured in the usual manner. The wound was then closed.

THE SPECIMEN.—On examining the specimen it was seen that the tumour had ulcerated through the gastric mucosa for an area of about 1 in. It had evidently caused the symptoms by direct pressure on the lower end of the ureters and bladder.

The tumour was submitted to Professor S. L. Baker of the Department of Pathology, Manchester University, who reported as follows: "*Endothelioma.* This is an unusual tumour and its appearance does not suggest an origin from the gastric or intestinal mucosa. It is composed of masses of rounded cells with central nuclei and clear vacuolated cytoplasm (*Figs.* 486, 487). In places there are spaces lined by endothelium and containing fluid which may be lymph. The appearance of the vacuolated cells suggested a renal origin, but frozen sections stained for fat showed neither neutral fat nor lipoid; a renal origin is, therefore, very improbable.

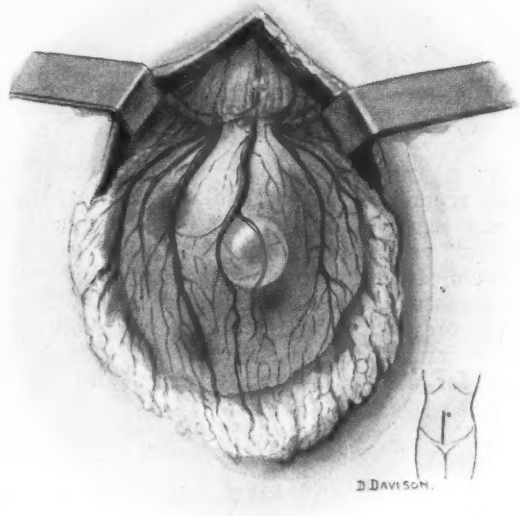

FIG. 485.—The tumour in situ. Re-drawn from an operative sketch.

On the whole I think it is probably an endothelioma, possibly of lymphatic origin. It is difficult to assess the grade of malignancy; cytologically it is not highly malignant, but would no doubt recur locally if not completely removed."

PROGRESS.—After the operation the patient was closely questioned about his symptoms but resolutely denied anything in the nature of dyspepsia, vomiting, or melæna. He passed urine normally within a few hours of the operation, made an uninterrupted recovery, and was discharged from hospital on Feb. 10, 1943. When last seen, in May, 1947, he was at work and in normal health. There was no evidence of recurrence.

COMMENT

Large tumours of the pelvic viscera may, of course, not uncommonly cause retention of urine, and from time to time tumours of other organs become impacted in the pelvis. There appears, however, to be no record in the literature of a previous case in which a tumour of the stomach presented the symptoms of sudden complete obstruction of the urinary pathways.

From the histopathological viewpoint, too, the case is not without interest. Large exogastric tumours growing between the layers of the great

omentum are usually myosarcomata (Schroeder and Schlattenberg, 1943) and these often show areas of degeneration and cystic change. But there exists as well a small group of tumours in which "the gross appearance is very similar to that of definite myosarcoma" (Ewing, 1940) but the histological findings "are more doubtful". One or two of the members of the group cited by Ewing have shown the microscopical characteristics of an endothelioma, and the present case seems to be of the same nature.

My grateful thanks are due to Professor S. L. Baker for his pathological report and for the microphotographs, and to Professor John Morley, under whose care the case was admitted, for permission to record it.

FIG. 486.—A low-power view of the tumour, showing cellular areas and spaces lined by endothelium. H. and E. (× 18.)

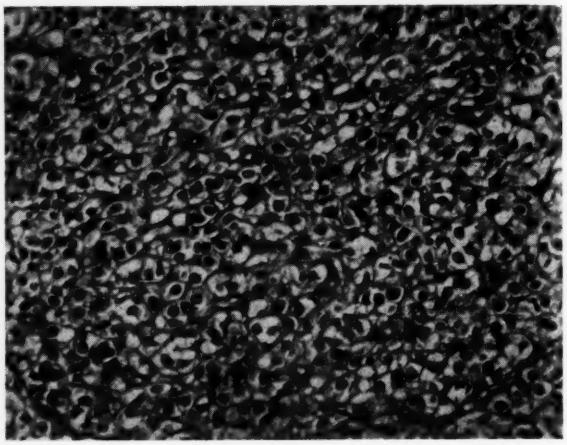

FIG. 487.—A high-power view of a cellular area, showing the rounded cells with their deeply stained nuclei and abundant cytoplasm. H. and E. (× 210.)

The drawing of the tumour was made by Miss D. Davison from an operation sketch of the specimen.

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SOLITARY PLASMOCYTOMA OF THE LONG BONES

BY JUDSON T. CHESTERMAN, SHEFFIELD

THE purpose of this 'follow-up' report is to try to elucidate the prognosis of patients with solitary plasmocytoma of long bones. It has generally been looked upon as the precursor of the well-known multiple form of myelomatosis, for solitary lesions of the flat bones such as the ribs appear to be invariably followed by the multiple form even if radical surgery is attempted in the apparently localized stage of the disease, though no such tendency to spread always occurs if a vertebra is involved. An interesting point is that Bence-Jones proteosuria has been found in extensive solitary lesions but never in association with solitary lesions of long bones (Willis, 1941).

From 1897 up to the present time there are not quite twenty satisfactory records of solitary plasmocytoma of long bones available, and of these I have only been able to find 4 which have been followed up for three years or more, as most seem to have died of intercurrent disease shortly after the bony lesion was discovered. The case reported by me (Chesterman, 1936) has been followed up exactly twelve years from the date of amputation (August, 1935) and has remained well. Complete radiographs of the patient's skeleton in 1944 showed no abnormality.

The four cases are :—

Bone involved	*Survival in Years*	*Treatment*	*Recorded by*
Femur	4	Amputation	Rogers (1930)
Humerus	8	Amputation	Stewart and Taylor (1932)
Humerus	9	Curettage and bone-graft	Shaw (1923) Willis (1941)
Tibia	12	Amputation	Chesterman (1936)

This suggests that there is, in the words of an editorial of the *Journal of the American Medical Association* (1935) "A localized form, amenable to surgical therapy and offering a favourable prognosis".

I gratefully acknowledge the kindness of Mr. J. B. Ferguson Wilson in allowing me to follow up this patient.

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WILLIS, R. A. (1941), *Ibid.*, **53**, 77.

A CASE OF MULTIPLE CANCERS

By CONSTANCE M. OTTLEY

THIS case, illustrating the occurrence of three apparently primary malignant growths which gave a favourable response to treatment, lends support to the idea that, paradoxically, an unusual susceptibility to cancer may be linked with a high degree of resistance to it.

CASE REPORT

M. C., an ex-actress, a widow and the mother of four children, was first seen in June, 1930. She gave her age as 42, but was strongly suspected of having deducted ten years. She complained of a lump in the left breast, first noticed six and a half years previously, and of irregular vaginal bleeding for the past few weeks. The menopause had taken place three years before.

Examination disclosed a typical carcinoma of the left breast, adherent to the skin and to the pectoralis major. No evidence was found of spread to the regional glands nor of distant metastases. X-ray examination of the chest was negative. Vaginal examination showed a lacerated cervix with what was mistakenly thought to be a simple erosion.

Radical amputation of the breast was performed one week later. Microscopical examination confirmed the presence of a scirrhous carcinoma: no secondaries were found in the glands.

In August, 1930, the patient was admitted to the Westminster Hospital for post-operative radium 'bomb' therapy. During her stay in hospital she again had some vaginal bleeding and examination disclosed a plaque growth involving the anterior and right lateral aspects of the cervix and extending towards the bladder. Biopsy confirmed that the growth was a squamous-celled carcinoma. She was treated for this with radium applications according to the Stockholm technique.

The patient has come fairly regularly for follow-up examination during the succeeding years. On each occasion she was free from any sign of recurrence. In November, 1942, however, she complained of pruritus vulvæ, and examination disclosed an atrophic, cracked condition of the skin of both labia majora, with a small area of ulceration on the inner aspect of the left labium majus and one enlarged, soft gland in the left groin. It was decided to excise the vulva, and this was done in December, 1942. Microscopical examination showed that the ulcer was in fact an early squamous-celled epithelioma. The regional glands, which had not been included in the scope of the operation, were removed by block dissection of both groins three weeks later; microscopically they were free from growth.

The patient made a good recovery and remained well until in January, 1944, a large, hard gland was discovered in the right groin. No biopsy was done, but the patient was immediately referred to the Royal Sussex County Hospital for X-ray therapy. The gland disappeared, but in April, 1944, a similar gland appeared in the left groin. A second course of X-ray therapy was followed by disappearance of the gland.

Since then there has been no further sign of recurrence of any of the growths, and now, seventeen years after the first operation and five years after the last, the patient is in good health and complains of nothing but increasing deafness and the disabilities associated with osteo-arthritis of the larger joints.

DARNING NEEDLE THROUGH THE HEART

By T. HOLMES SELLORS AND J. R. M. WHIGHAM

THE presence of a foreign body in the heart is sufficiently uncommon to merit attention, particularly when the injury occurs in the course of ordinary domestic duties. The chief point of interest in this case lies in the fact that practically no disability was occasioned by transfixion of the heart with a needle. The removal of this foreign body was a simple and straightforward affair.

CASE REPORT

A housewife, aged 38 years, was mending socks with a large darning needle. She went to answer a knock at the door and stuck the needle in her frock as she rose to open it. The door opened suddenly hitting her chest and pushing the needle into her left breast. An immediate attempt was made to remove it but it had disappeared through the skin of the lower margin of the breast.

Some four hours later she was examined radiologically in hospital and an attempt was made to remove the needle through a small incision under local anæsthetic. No trace of the needle was found though the parietes were explored. The patient suffered no discomfort, but further radiography and screening showed that the needle was moving with the heart pulsations and it was inferred that this foreign body was lying within the heart substance.

The patient was transferred to St. Andrews Hospital, Bow, and four days after the accident the removal of the foreign body was undertaken. An anæsthetic was given by Dr. Parry Brown; this consisted of pentothal and curare with closed-circuit gas–oxygen. A left submammary incision was made avoiding the previous exploration scar and the pleural cavity entered through the 4th intercostal space, with division of the 4th and 5th costal cartilages. When the lung had retracted the pericardium was seen to be œdematous and slightly thickened. It was incised for 2½–3 in. and some blood-stained frothy fluid was seen within the pericardial sac. The surface of the heart was injected and unduly red, and close to the descending branch of the left coronary artery there was a faint dimple. This area was carefully palpated and a certain firmness suggested one end of the needle. The heart muscle was pressed down on each side of the dimple and the end of the needle was exposed. This was grasped in forceps and withdrawn steadily and firmly against slight resistance. There was no bleeding from the puncture and no disturbance in rhythm apart from an occasional extrasystole during manipulation.

As far as can be judged, the needle had skewered the right ventricle from before backwards. It was lying in an anteroposterior plane, apparently with the point embedded in the vertebral column. This gave a curious rotatory and irregular movement to the heart which was observed on opening the pericardium and which disappeared after the foreign body was withdrawn.

The pericardium was not sutured and after instillation of 500,000 units of penicillin the chest was closed. The operation was withstood perfectly well and convalescence was uneventful, the patient being discharged seventeen days later. Electrocardiograms taken showed no abnormality and the later course of this patient was uneventful.

REVIEWS AND NOTICES OF BOOKS

The Appendix. By R. J. McNeill Love, M.S. (Lond.), F.R.C.S. (Eng.), F.A.C.S., Surgeon, Royal Northern, Mildmay Mission, and Metropolitan Hospitals; etc. 7¼ × 4¾ in. Pp. 186 + vi, with 54 illustrations. 1947. London: H. K. Lewis & Co. Ltd. 12s. 6d. net.

Many books have been written dealing with the appendix and many may think that any further book on the subject would be quite superfluous. However, after reading this small monograph of just under two hundred pages, one is forced to admit that it is a really useful book and one that should be in the hands of every medical student.

Mr. Love is a well-known author and a practical surgeon, and this book is the outcome of his experience over a long period. He advocates a rational treatment of selected cases of acute appendicitis, rather than by rule-of-thumb methods. He puts forward cogent reasons for the expectant treatment of acute appendicitis in which a mass is present, and this treatment is now universally accepted.

This little book contains a fund of information and is delightfully written.

Chirurgie de la Main. By Marc Iselin, Chirurgien de l'Hôpital Américain. 9¾ × 6⅝ in. Pp. 360, with 135 illustrations. 1946. Paris: Masson et Cie. Fr. 600.

This comprehensive book on injuries and infections of the hand is one of the standard works on the subject. The fourth edition embodies the most recent views and advances with the exception of the use of penicillin. The author states he has had little experience of this, but stresses that it does not replace surgical treatment if suppuration occurs. The book is well illustrated, but suffers from the lack of a stiff binding which appears common in French productions.

Retropubic Urinary Surgery. By Terence Millin, M.A., M.Ch. (Dubl.), F.R.C.S., F.R.C.S.I., Surgeon, All Saint's Hospital for Genito-urinary Diseases; etc. 9⅝ × 6¾ in. Pp. 208 + vii, with 163 illustrations, some coloured. 1947. Edinburgh: E. & S. Livingstone. 25s. net.

The publication of the author's account of a new route of approach for prostatectomy about two years ago aroused widespread interest amongst surgeons in this country and later on the Continent, and it soon became evident that the retropubic route was worthy of serious consideration. The original description was necessarily brief, and the present work sets out to remedy this defect and to give full details of the operation as now performed, with the modifications which have been adopted and the variations which make it adaptable for fibrous, calculous, and malignant prostates, post-prostatectomy obstruction, prostatic abscess, and intrapelvic rupture of the urethra, as well as for benign hypertrophy. It may be said at once that the account is full and presented in such a way that any competent surgeon should be able to follow the technique. The main disadvantage of the original operation was the liability to post-operative obstruction at the bladder neck; the need for excision of a wedge of the trigone or for the re-trigonization stitch of Harris to prevent this is now recognized and described as an essential part of the operation.

That the route is a good one on theoretical grounds cannot be denied, for it gives the most direct access to the gland without the need for traversing the bladder or the perineum. The author has shown that the practical difficulties are readily overcome and it is only custom and training which make some surgeons more at home with the suprapubic or perineal methods of enucleation. The cave of Retzius is no longer sacrosanct and the complications formerly feared from surgery therein do not occur.

Whilst retropubic prostatectomy in all its aspects occupies the main part of the book, there is much other matter of general importance. The classification of prostatic obstruction into eight varieties is largely based on the work of Randall and is comprehensive enough for the urologist rather than the general surgeon. The history of the extravesical route is fairly presented, and, although Van Stockum may have been the first to use it, the credit for making it generally available must go to Millin, just as Freyer's name is associated with the method first used by Fuller and Magill.

The book also contains an account of the author's operation for stress incontinence in women; it is perhaps unfortunate that the illustrations included do not represent the exact technique described in the text, but the modifications made since the blocks were prepared are not of fundamental importance.

The book is generously illustrated, but, as is almost inevitable in a first edition, there are a few mistakes in the references to the illustrations, e.g., on pages 148 and 149. *Fig.* 123 is inverted, and the knots to be tied in *Fig.* 116 would be inside the urethra and not outside as recommended in the text. These, however, are minor matters which will doubtless be corrected in the next edition. We should also prefer to meet the word 'visualized' a little less often in place of the simpler English word 'seen'.

Even if the retropubic method does not prove to be the last word in prostatectomy, Mr. Millin has rendered a great service in focusing attention on the possibility of making the operation safer, less uncomfortable, and of shorter convalescence than the older methods, and we congratulate him.

A Manual of Fractures and Dislocations. By Barbara Bartlett Stimson, A.B., M.D., Med.Sc.D., F.A.C.S., Assistant Professor of Clinical Orthopedic Surgery, College of Physicians and Surgeons, Columbia University, New York City. Second edition. 7⅝ × 5⅛ in. Pp. 223, with 98 illustrations. 1947. London: Henry Kimpton. 17s.

The second edition of this manual has been thoroughly revised and brought up to date.

The book is intended primarily for medical students and it certainly fulfils that function, for it provides an organized guide to the principles involved in the treatment of fractures and dislocations.

The author has a lucid style and the line drawings are excellent and well chosen. The blank pages for notes should prove of real usefulness to students, who can supplement the text with a few facts about cases they have actually seen.

Practical Points in Penicillin Treatment. By G. E. Beaumont, D.M. (Oxon.), F.R.C.P. (Lond.), Physician to the Middlesex Hospital, and K. N. V. Palmer, M.B. (Cantab.), M.R.C.P. (Lond.), Acting Medical Registrar to the Middlesex Hospital. Second edition. 7¼ × 4⅞ in. Pp. 18 + vi. 1947. London: J. & A. Churchill. 1s. 6d.

The publication of a second edition of this useful pamphlet has given the authors the opportunity of revising dosages and adding a few notes on changes in technique which have been introduced since the first edition appeared.

The value of the booklet will be still further enhanced in future editions by the inclusion of a fuller account of the use of penicillin in acute and chronic infections of bone, and by references to recently published experience of its employment in the treatment of infected fingers, mastitis, urinary infections, and peritonitis, including puerperal infection.

Radical Surgery in Advanced Abdominal Cancer. By ALEXANDER BRUNSCHWIG, M.D., Professor of Surgery, University of Chicago. 9½ × 6¾ in. Pp. 324 + xii, with 118 illustrations. 1947. Chicago, Ill.: The University of Chicago Press. (London: Cambridge University Press.) 42s. net.

EARLY diagnosis, and treatment before the disease has spread, are so obviously the ideals to be aimed at in dealing with cancer in any part of the body that our first reaction to the title of this book may well be to ask whether the surgery of advanced abdominal cancer is worth considering at length. On second thoughts, however, it must be admitted that for the present the ideal of early diagnosis of many visceral growths is still out of reach, and we must therefore lay our plans for attack upon cancer which is already advanced and may be, by some standards, 'inoperable'.

It is clear that the decision to proceed with one of these resections which may mean the removal of part or the whole of several organs must be a matter of nice judgement in every case, and anyone embarking on this heroic surgery must be prepared for disappointment, which makes the occasional triumph all the sweeter. But the chief contributions made by this book are the account of the deliberate and careful pre-operative preparation which makes these operations possible, the well-planned strategy of major abdominal surgery, and the details of post-operative management—in short, it supplies the science which supports and justifies surgical enterprise. It is based upon the clinical and pathological records of 100 cases, and shows that, although half of these ended in disappointment or failure, the other half were well doing, and should be both a guide and an encouragement, particularly to every young general surgeon.

The Causation and Treatment of Delayed Union in Fractures of the Long Bone. By KENNETH W. STARR, O.B.E., M.S., F.R.C.S., Surgeon, Sydney Hospital, N.S.W. Being the Jacksonian Prize Essay. 9⅝ × 6¾ in. Pp. 223 + xiv, with 106 illustrations. 1947. London: Butterworth & Co. Ltd. 42s. net.

THIS monograph is in reality the Jacksonian Prize Essay which the author won at the Royal College of Surgeons of England. The subject is one of vast importance to all surgeons who are concerned with the treatment of fractures. The author has presented his facts and findings in a very practical and lucid manner.

The monograph is divided into three parts. Part I is concerned with the morphogenesis of bone and is a real contribution to our knowledge. The chemistry of bone, the biochemistry of the bone salts, and the physiological relationships of bone anaplasia are dealt with in a masterly manner. Part II is devoted to the healing of fractures, and every aspect of this problem is considered in the minutest detail. The hydrogen-ion concentration at the fracture site, the role of phosphatase, metabolism, and mechanism of calcification, and the rate of healing of fractures are but some of the subjects covered in this section.

Part III deals with the aetiology and treatment of delayed union and is by far the largest section in the book. The management of open fractures and of septic fractures is considered in detail and sound practical advice is forthcoming. The place and role of penicillin is dealt with in an appendix and many clinical cases are included.

A comprehensive and valuable bibliography completes a most useful book.

This monograph is not only a great credit to the man who wrote it, but also a credit to the Royal Australasian College of Surgeons, of which the author is a Fellow.

Reconstructive and Reparative Surgery. By HANS MAY, M.D., F.A.C.S., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; etc. With a Foreword by JAMES BARRETT BROWN, M.D., F.A.C.S. 10 × 6¾ in. Pp. 964 + xxi, with 363 illustrations in text and section of illustrated cases. 1947. Philadelphia: F. A. Davis Co. $15.00.

THIS large volume devoted to reconstructive and reparative surgery is divided into five parts. In Part I a detailed account is given of the preparation of the patient before any operative treatment is undertaken.

The general technique of grafting of the various types of tissues is well described, as is also the treatment of burns, wounds, and scars.

Part II deals with the plastic surgery of the head and neck, including the osseous framework of the face. The surgery of cleft palate is dealt with in considerable detail.

Part III is devoted to the surgery of the trunk. The various operations for the cure of pendulous breasts seem to overstress the condition from the surgical angle. Operations for inverted nipples seem to be more in favour in the United States than they are in this country.

The construction of an extrathoracic œsophagus is described in detail. The various operations for the cure of hypospadias are outlined, but no mention is made of Edmunds's operation, which seems to be an omission.

Part IV is concerned with the extremities and is perhaps the most important part of the book, as the treatment of infections of the hand, the various amputations, the surgery of blood-vessels, muscles, tendons, and nerves are all considered in this section.

Part V is devoted to a large number of clinical cases, all of which provide concrete evidence of the usefulness of the various operations carried out for the cure of the condition.

There can be no doubt that this book has been planned to make plastic and reconstructive surgery of the entire body better known to the general surgeon. The author is to be congratulated upon having succeeded in this enormous task.

The book is profusely illustrated, but it is a great pity that on the whole the illustrations are so poor. If the illustrations were of the same excellence as the text, the book would be a first-class production.

Inter-Allied Conferences on War Medicine 1942–1945. Convened by the Royal Society of Medicine. Edited by Major-General Sir HENRY LETHEBY TIDY, K.B.E., M.D., assisted by J. M. BROWNE KUTSCHBACH, M.B., B.Ch., D.P.H. 8½ × 5½ in. Pp. 531. Illustrated. 1947. London: Staples Press Ltd. 50s. net.

THIS interesting volume contains communications delivered at Conferences held by the Medical Services of the Allies stationed in the United Kingdom between December, 1942, and July, 1945. The Lectures were given at the Royal Society of Medicine under the Presidency of Sir Henry Tidy and they proved a great success.

It was during this period that large numbers of troops were under training in the United Kingdom, and the medical officers attached to the various units were allowed to attend these Conferences.

The Conferences were attended by over 6500 medical officers. They were under strict security and no reports were published. Now in the present volume medical men all over the world can read the fascinating story

of the application of medicine and surgery to war, contributed by officers of all ranks, of many countries, and of many services.

The various problems of surgical treatment, blood transfusion, neuropsychiatry, venereal diseases, and German concentration camps are all set out in a very lucid way in this volume.

Illustrations of Regional Anatomy. By E. B. Jamieson, Senior Demonstrator and Lecturer-Emeritus, Anatomy Department, University of Edinburgh. Seventh edition. 8 × 6¼ in. In seven sections. Section I, Central Nervous System (51 Plates) 12s.; Section II, Head and Neck (64 Plates), 15s.; Section III, Abdomen (44 Plates), 10s.; Section IV, Pelvis (35 Plates), 8s. 6d.; Section V, Thorax (32 Plates), 7s. 6d.; Section VI, Upper Limb (42 Plates), 10s.; Section VII, Lower Limbs (52 Plates), 12s. 1947. Edinburgh: E. & S. Livingstone Ltd. In one bound volume. 75s.

THE new seventh edition of the pictorial regional anatomy contains some new drawings, while some of the original ones have been re-drawn. It still maintains its place as the best atlas of anatomy that has so far been produced. It will remain as popular with the student as previous editions, for it enables him to obtain a quick visual knowledge of the structure and framework of the human body. An excellent production.

British Surgical Practice. General Editors: Sir ERNEST ROCK CARLING, F.R.C.S., F.R.C.P., Consulting Surgeon, Westminster Hospital, and J. PATERSON ROSS, M.S., F.R.C.S., Surgeon and Director of Surgical Clinical Unit, St. Bartholomew's Hospital; Professor of Surgery, University of London. In eight volumes. 8⅝ × 6⅝ in. Volume I. Pp. 486 + xxxii, with 50-p. index. 228 illustrations. Volume II. Pp. 540 + xxvii, with 35-p. index. 318 illustrations. 1947. London: Butterworth & Co. Price per volume £3, Index £1.

THE first volume of this comprehensive work of surgery will whet the appetite of surgeons all over the world and make them look forward to the seven other volumes that are to follow.

The format and style of this volume is similar to that of the *British Encyclopædia of Medical Practice*, and the two general editors have chosen a very strong band of consultant editors to help them in their important task. That such a work as this is wanted by the surgical profession there can be little doubt; especially at this time when young surgeons from the services are returning to civil practice again.

The editors in chief, Rock Carling and Paterson Ross, themselves lend that maturity and rich clinical and operative experience which is necessary in a work of such magnitude.

The various chapters are written by experts in the particular topic, and in each case the subject is dealt with in a comprehensive and up-to-date way. It would be very difficult to pick out separate articles for praise as they are all universally good, but those on Actinomycosis by Cope, Amputations by Perkins, Arteries by Learmonth, and the Autonomic Nervous System by Telford are truly excellent.

The illustrations are first-class, the paper and printing good; it is, in fact, a first-class production.

It will be the standard reference book on surgery in this country.

The second volume of this comprehensive surgical practice has only whetted our appetites; it contains some thirty-eight chapters dealing with surgical conditions from Backache to Bursa. The whole volume is full of useful and practical information, and the illustrations are excellent and well chosen. It is refreshing to see such a wealth of new original illustrations, and they certainly enhance the value of the book.

It is difficult to single out any chapters for special praise as every chapter is a real credit to the individual author, but perhaps the chapter on bladder tumours by Riches is outstanding in every way; it deals with the subject in a masterly fashion. The chapters devoted to surgical affections of the brain are excellent, especially the chapter dealing with brain tumours by Cairns and Pennybacker.

This work is a great credit to British surgery and the publishers are to be congratulated on the way they have produced the book in these difficult times. The paper is good, the text clear, the illustrations superb, and the index reliable. We look forward to seeing Volume III in the not too distant future.

Essentials of General Anæsthesia. By R. R. MACINTOSH, M.A., M.D., F.R.C.S., D.A., Nuffield Professor of Anæsthetics, University of Oxford; and FREDA B. BANNISTER, M.A., M.D., D.A., Honorary Anæsthetist, Chester Royal Infirmary, late First Assistant, Nuffield Department of Anæsthetics, University of Oxford. Fourth edition. 8¾ × 5½ in. Pp. 358 + xi, with 247 illustrations. 1947. Oxford: Blackwell Scientific Publications Ltd. 30s. net.

IN addition to a general revision, the authors have enlarged this excellent book by considerable additions to the chapter on endotracheal anæsthesia, so that it now forms a complete guide to the student and young anæsthetist. A chapter on trichlorethylene has been added, and this is rather disappointing, as it is lacking in details of administration, and makes no mention of the possibilities of using this agent with nasal gas and oxygen for dental anæsthesia; moreover, the occurrence of cardiac irregularities with this agent is but barely stated, although many anæsthetists consider that this fact alone is a great argument against the use of trilene.

In considering the use of pentothal the authors recommend the rapid injection of an estimated dose, a procedure which may be safe in expert hands, but which may lead the inexperienced into dangerous habits. The risk of inhalation of blood if pentothal is used as a sole anæsthetic for dental extraction is not stressed, nor is the danger of vomiting if the drug is administered to a patient with a full stomach, such, for example, as a case of intestinal obstruction.

These, however, are minor blemishes and it seems almost churlish to mention them; in the main the book is excellent, and its clarity of description and its magnificent illustrations running concurrently with the text make it a model among text-books. Its bias is towards anæsthesia for dentistry, and if the authors could find the opportunity to produce a supplement dealing with subjects such as spinal and local anæsthesia it would be a welcome addition to the list of student text-books.

Essentials of Clinical Proctology. By MANUEL G. SPIESMAN, B.S., M.D., Proctologist, Mt. Sinai and Edgwater Hospitals. With a Foreword by ANTHONY BASSLER, M.D., F.A.C.P., LL.D. 9 × 6 in. Pp. 238 + x, with 61 illustrations. 1947. London: William Heinemann (Medical Books) Ltd.

THIS small book has many excellent features and, seeing that it is only intended to convey the essentials of diagnosis and treatment, the author has managed to pack a great deal of useful information within its compass of approximately 230 pages and 29 fairly short chapters.

One good feature is the clarity of the illustrations, particularly the sectional drawings of the anorectal region, many of which conform to a uniform pattern or what one might term a single basic diagram, but unfortunately the side-by-side arrangement shown of the three portions of the external sphincter does not

fit in with the accepted conception of this muscle; the deep portion is shown far out in the ischiorectal fossa and its upper end, looking like the stalk of a pear, seems to be at a loose end rather than blending with the anorectal ring.

Although Milligan and Morgan's description of the anorectal ring is given, the chapter on fistula follows the old lines and the modern classification of fistulæ is not mentioned. A diagram illustrates Goodsall's rule in regard to fistula-in-ano, and the relation of external openings to the transverse anal line is wrongly ascribed to Salmon—how these errors are transmitted from book to book!

One of the most controversial chapters, and the most difficult to follow, is Chapter VII, on the pecten band: a diagram shows this as a thick structure almost equal in width to the internal sphincter and extending from the anal intermuscular septum to above the pectinate line. The operation for division of this alleged structure via a hinged proctoscope fills us with awe and wonder: the deep incision which is depicted in the anal canal with inadequate external drainage appears to us a very questionable procedure, inviting subsequent complications from infection and pocketing.

Although one major operation—namely, the Wreden-Stone operation for prolapse—is described and illustrated, we gather that the author is chiefly concerned with the minor procedures, and seven operations which may be considered for rectal carcinoma are listed and briefly described in little more than half a page. Yet even in the limited field of minor proctology we notice some curious variations from modern practice. For instance, in regard to hæmorrhoids, the author while advocating 5 per cent phenol in oil, only injects 1 or 2 c.c. into the centre of the pile mass and repeats the injection three times a week. The differentiation of piles into three stages or degrees is not mentioned. The clamp and cautery operation is the one of choice, and we regret to see that for strangulated hæmorrhoids there is no mention of immediate reduction but instead he advocates immediate operation. For fissures an injection of 1 c.c. of nupercaine in oil anteriorly and 1 c.c. posteriorly seems to be an ultra-cautious dose, and the same remark applies to the suggested dosage of 1 c.c. per quadrant in the treatment of chronic pruritus ani. For pilonidal cyst what appears to be a marsupializing operation is recommended, with suture of the wound margins to the floor of the cyst with a blanket stitch of heavy braided black silk; complete healing occurs in about six weeks. Excision and closure of the wound by primary suture is not mentioned.

Symptomatology is described clearly and succinctly, and the more medical chapters, such as those on proctitis, venereal diseases, tuberculosis, constipation, and diets, are sound and practical.

At least six proper names are misspelt in various places in this book—Broders, Dukes, Castellani, Yeomans, Wreden, and Moschcowitz.

Although some conditions of topical interest such as amœbic granuloma and lymphogranuloma inguinale are described, there is a complete absence of references. There is, however, on p. 234, a Proctologic Reference Book List extending in alphabetical order from B (Bacon) to Y (Yeomans), and it is interesting to find under S, the author's name and title of this book already installed; we hope that this will prove a prophecy and that later editions, expanded and amended in the light of further experience, will justify this assumption.

The 1947 Year Book of Radiology. Edited by CHARLES A. WATERS, M.D., and IRA I. KAPLAN, M.D., F.A.C.R. Associate Editors: WHITMER B. FIROR, M.D., and SIDNEY RUBENFELD, M.D. 9 × 6 in. Pp. 416, with 287 illustrations. 1947. Chicago: The Year Book Publishers, Inc.

THIS well-known annual is divided into two sections—radio-diagnosis and radio-therapeutics—each with separate editors.

The radio-diagnostic section adequately covers the whole aspect of radiology, dealing with the various systems of the body in turn. The osseous system contains excellent accounts of arthritis mutilanus (opera-glass hands), multiple fractures in long bones of infants suffering from chronic subdural hæmatoma, and cranial localization of fibrous dysplasia of bone.

The cardiovascular system contains a large amount of interesting material. The extended use of lipiodol has enabled radiologists to diagnose with confidence such conditions as double aortic arch, some beautiful radiographs of which are contained in this volume. The gastro-intestinal system is well covered and profusely illustrated.

The genito-urinary system and the nervous system are dealt with in a practical way and all the new methods of X-ray diagnosis are included and illustrated.

Radio-therapeutics, including a chapter on radiation biology and physics, are set out in an interesting manner, and all that is new in this branch of medicine has come under review.

A most useful book for not only radiologists but also physicians and surgeons as well.

Radium Dosage: The Manchester System. Compiled from articles by RALSTON PATERSON, F. W. SPIERS, S. K. STEPHENSON, H. M. PARKER, M. C. TOD, and W. J. MEREDITH. Edited by W. J. MEREDITH, M.Sc., F.Inst.P., Christie Hospital and Holt Radium Institute, Manchester. 9¾ × 7¼ in. Pp. 124 + vii, with 38 illustrations and 4 plates and tables. 1947. Edinburgh: E. & S. Livingstone. 15s. net.

A BOOK in which is collected and co-ordinated a series of papers published by acknowledged experts in this specialty during the past thirteen years must be of great use to radiotherapists and those surgeons who have enough expert knowledge to read and digest it. To those who have not, then it should be an effective reason for them to leave radiotherapy in the hands of those specially trained and qualified in this field.

It is perhaps still arguable in the minds of some as to who should do the surgery of access, but surely the time has now arrived when there is no doubt as to who should estimate, arrange the method of application, and accurately record the dose. It can only be done by a qualified radiotherapist assisted by a physicist specially qualified and trained to do such work.

It is of the utmost importance that whatever mode of treatment is adopted in malignant disease, the first should be adequate. If this is not so, then all surgeons and radiotherapists know how difficult or even impossible it is for any subsequent treatment to be of much avail.

There should be no excuse for inadequate treatment of a case if it is carried out on a consultative basis by surgeon-radiotherapist and pathologist, as it is to be hoped that there is now no radiotherapy centre without a fully-trained physicist on its staff.

The importance of such physicists is shown by the fact that four of the six authors and also the editor is a physicist. The book is divided into two parts—first, the clinical aspects of radium dosage, which occupies forty-three of the hundred and twenty-four pages; the remainder, including two Appendices, deals with the physical aspects.

There is a dearth of radiotherapists and consequently of radiotherapy departments, and many which are in being are under-staffed. Meanwhile cancer is increasing and, whatever the views of surgeons may be, none will deny that radiotherapy is at least a useful adjunct in treating the disease.

Consequently this book, although expounding the view of one particular school, should become a vademecum for all those training to practise as radiotherapists.

There are, as in any good teaching text-book, a number of dogmatic statements, but they have the weight of experience behind them. The Editor in his introduction says, " In general the study of dosage in practical radium therapy raises two main questions: (1) How much radium will be required? (2) How *must* it be arranged? " There may be a difference of opinion in answering the first; there certainly will be in the case of the second. Its meaning would be better conveyed if " the *could*, the *should*, the *might be*," were used rather than " the inevitable *must* ".

Hey Groves' Synopsis of Surgery. Edited by Sir CECIL P. G. WAKELEY, K.B.E., C.B., Senior Surgeon to King's College, London, etc. Thirteenth edition. $7\frac{3}{4} \times 4\frac{7}{8}$ in. Pp. 637 + viii, with 193 illustrations and 13 coloured plates. 1947. Bristol: John Wright & Sons. 25s. net.

THE previous, twelfth, edition of this book was reviewed in this JOURNAL in July, 1945 (p. 98). It speaks well for its popularity that another edition is already in demand. This may be accounted for to some extent by the small amount of paper allowed the publisher by the authorities. Be that as it may, the Editor has taken the opportunity to revise and discard some of the old, and include new methods and matter which have been established during the last two years. The book has thus been kept within reasonable bounds of space and price. At the present time we are living, almost unconsciously, through a renaissance in surgery. We certainly are in other aspects of daily life. It is too early yet to describe this as *progress*. The word really only means motion in one direction, and whether it leads to paradise or perdition only time will show.

In spite of the spate of new operations and therapy in surgery, it is well to remember that surgery is mostly illogical except the traumatic variety.

The surgeon and consequently the student are apt to forget that surgery interests itself mainly with effects, and only recently with the newer methods has a real endeavour been made to rectify causes.

These newer methods have been properly stressed in this edition and first principles are emphasized throughout. Most of us are hoarding something, but it is the duty of a good editor, as in the case of a good housewife or card player, to make a proper discard at the right time, and not to clutter up, a book, a hand of cards, or a house, with useless material.

This book is an example of good editing and a student would be wise to secure it at the beginning of his clinical career. Used in the proper manner and with due reflection, it will help him not to add to the examples " when cause follows effect " which may be when the doctor goes to his patient's funeral.

Pathology of Tumours. By R. A. WILLIS, D.Sc., M.D., F.R.C.P., and Sir William H. Collins Professor of Human and Comparative Pathology, Royal College of Surgeons, London. $9\frac{5}{8} \times 6\frac{5}{8}$ in. Pp. 1044 + xxiii, with 500 illustrations. 1948. London: Butterworth & Co. (Publishers) Ltd. 63s. net.

THIS is a book for which the medical profession has waited for many years, and the author is to be congratulated on his great effort. A large volume of nearly a thousand pages, packed with some five hundred illustrations, many of them microphotographs, is indeed a *magnum opus*.

Professor Willis has been fortunate in his material both at Melbourne and at the College of Surgeons in London, for he has had at his disposal a wealth of pathological specimens which cannot be equalled. It is refreshing to see that all the histological material is displayed as microphotographs throughout the book, and that the magnification is given in each case.

The author has a lucid and easy style and has the happy knack of giving a short précis of other pathological work dealing with any kind of tumour. His former work on " The Spread of Tumours in the Human Body " is well known in the pathological and surgical world, and this present volume may be looked upon as supplementary to the former one.

Although the book is addressed primarily to pathologists and research workers, yet it must be acknowledged that surgeons the world over will find this book of the utmost value to them, and it will remain an important reference volume to the medical profession as a whole.

The lay-out and format of the book are pleasing and the arrangement is practical, allowing for easy reference.

The illustrations are excellent, and every type and subtype of tumour formation is illustrated.

This book should enhance the teaching of pathology in this country and will prove of value to undergraduates and post-graduates alike.

An excellent production.

Traumatologia. By M. BASTOS ANSART. Pp. 823, with 762 illustrations. 1945. Barcelona: Editorial Labor S.A.

THIS is an important contribution by one of the leaders in the Latin world on the subject of injury.

Dr. Bastos Ansart, formerly Professor in Madrid, is now without university or hospital status and has written this comprehensive book from Barcelona, where he lives and works as a private surgeon. The clinical material published in this book has been collected during many years dedicated to the care of injured patients, both in a peace-time practice and in war, where, as a military surgeon, Dr. Bastos Ansart had a long and profitable experience.

The book contains a comprehensive study of injuries of all regions of the body, including the central nervous system, and the material is presented in such a manner as to make it of value to those engaged in the care of the injured patient. The author is particularly at home in those chapters devoted to limb surgery, but the sections on thoracic and abdominal injuries are also well worth reading.

In evaluating the work it must be remembered that the author, like so many Spanish surgeons, has been cut off from the outside surgical world for a period of several years and has not, therefore, had access to information on the more recent therapeutic advances—such as the exhibition of penicillin and the indications for early and adequate immobilization in recent wounds.

These small criticisms apart, the work must be considered an outstanding personal contribution to the study of traumatic surgery and one of the best in Spanish in existence.

The quality of the illustrations and general appearance of the book speak very highly indeed of the publisher's work.

The Essentials of Modern Surgery. Edited by R. M. HANDFIELD-JONES, M.C., M.S., F.R.C.S., and A. E. PORRITT, C.B.E., M.A., M.Ch., F.R.C.S. Compiled by 14 contributors. Third edition. $9\frac{5}{8} \times 6\frac{1}{8}$ in. Pp. 1256 + xix, with 644 illustrations, many in colour. 1948. Edinburgh: E. & S. Livingstone Ltd. 50s. net.

THE new third edition of this large volume has been thoroughly revised and brought up to date. Two new chapters have been added, one on chemotherapy and the other on amputations, while the chapter on anæsthetics has been deleted. We agree with the editors

that anæsthetics have now passed out of the hand of the surgeon and that this subject should be dealt with in a separate book.

The book is quite large enough as a reference volume and if it becomes larger in subsequent editions it will be unwieldy. One of the features of this book is the excellence and number of the illustrations, which could hardly be bettered.

A very sound comprehensive text-book of surgery.

The Medical Bookman and Historian. Crown 4to. Pp. 48, with covers. Issued monthly. London: Hardey & Blythe. Annual subscription, 25s.

WITH the 1947 November issue of *The Medical Bookman*, being No. 11 of Vol. I, is incorporated the first issue of *The Medical Historian*, and in an Editorial introducing the project, W. R. Bett explains that this conjoint arrangement is merely a convenience imposed by the out-of-joint times in which we survive. In more spacious days it would have appeared in its own cover, and the editor believes it would have been the first periodical devoted entirely to the history of medicine. The intention is not to make an appeal to the established historian, or, at least, not exclusively, but to endeavour to foster a regard, ripening into affection, for the history of all branches of the healing art.

With unerring frankness the editor nails his colours to the mast when he states that the policy will be "to link the history of medicine with its current practice and to try to elucidate current problems in the light of past experience and past errors". To look back is salutary for the would-be pioneer, and this seems to be the policy of the project. The new venture is dedicated to the memory of Sir William Osler, with the declared intention of using the spirit of history to leaven medicine. For the present, the pages of *The Medical Historian* will be bound with its elder brother, *The Medical Bookman*, of established reputation, though its management is to be in the hands of a separate editorial board.

This first issue shows that the auspices are favourable, and the contributions of F. N. L. Poynter, W. J. Bishop, J. A. Nixon, and W. R. Bett, make a good beginning.

In our view, this effort is fortunate in the manner of its inception, for the style and performance of *The Medical Bookman*, edited by F. Croxon Deller and W. R. Bett, is of recognized value and will assort well with its more pointedly historical fellow.

We wish the new venture every success.

Surgical Disorders of the Chest. Diagnosis and Treatment. By J. K. DONALDSON, B.S., M.D., F.A.C.S. (Lt.-Col., A.U.S.), Diplomat American Board of Surgery; Associate Professor of Surgery and in Charge of Thoracic Surgery, University of Arkansas School of Medicine; etc. Second edition, thoroughly revised. $9\frac{1}{8} \times 5\frac{3}{4}$ in. Pp. 485, with 148 illustrations. 1947. London: Henry Kimpton. 42s. net.

THE second edition of this book devoted to the surgical diseases of the chest has been revised in a very practical manner and all the new knowledge which has accrued from the second world war has been incorporated.

The book is written in a clear, easy style and prominence has been given throughout to diagnosis and treatment of the various diseases. Surgical technique is well displayed and should prove of real value to surgeons who are interested in this branch of surgery.

Although there are nearly one hundred and fifty illustrations, yet on the whole they are of mediocre and indifferent quality. Some are excellent; others are very poor and impair the good quality of the book. The radiographs are poor and *Fig.* 65 is upside down.

Modern books on surgery demand good illustrations if they are to be of real value to the reader. It is to be hoped that the author will see to it that the next edition of this book is not spoilt by the illustrations it contains.

The Internal Fixation of Fractures. By CHARLES SCOTT VENABLE, M.D., F.A.C.S., and WALTER GOODLOE STUCK, M.D., M.S. (Orth. Surg.), F.A.C.S. With a Foreword by RALPH K. GHORMLEY. $10 \times 6\frac{5}{8}$ in. Pp. 237 + xii, with 84 illustrations. 1947. Oxford: Blackwell Scientific Publications. 30s. net.

THIS interesting monograph deals with the use of metal appliances in surgery and in orthopædic surgery in particular. A most valuable historical introduction leads to a review of the experimental and clinical work on which modern practice is based. Special attention is directed to the effects of electrolysis, and the previous work of the authors on this change in metal plates and screws is given in detail. The history of steel development, of the 'stainless steels', vitallium, and other metals and alloys commonly used, with details of their composition and properties, forms an interesting background to the whole subject.

Most surgeons realize the danger of using dissimilar metals in the same internal appliance, but fewer comprehend the exact composition of the material they commonly use or the fact that some hundred different types of 'stainless steel' alone exist. Fewer still of the theatre nursing staff realize this, and the danger of mixing old and new stocks of plates and screws, with the result that dissimilar alloys are thus unwittingly used at operation, is pointed out.

The internal fixation of the common fractures is described and the authors' views on technique will no doubt lead to considerable controversy. In all fairness it must be said that they repeatedly advise conservative measures, and, although several bizarre procedures are described, such as the digital palpation of the fractures of the femoral neck through the incised capsule during the insertion of a Smith-Petersen nail, they do not attempt to be dogmatic. This book is a valuable addition to the library of the fracture surgeon. References are given at the end of each chapter—over four hundred following the chapter on fractures of the lower extremity.

Detailed specifications of screws and plates, the report of the Sub-committee of the American College of Surgeons on the subject, forms a useful appendix.

Short Textbook of Surgery. By C. F. W. ILLINGWORTH, C.B.E., M.D., Ch.M., F.R.C.S. (Edin.), Regius Professor of Surgery, University of Glasgow. Fourth edition. $9\frac{1}{4} \times 6$ in. Pp. 680 + viii, with 227 illustrations. 1947. London: J. & A. Churchill Ltd. 30s. net.

TEXT-BOOKS of surgery written by one author are becoming rare, and it is a pleasure to see the fourth edition of this well-known and popular student's manual. It is, of course, impossible for one man to be an expert in every branch of surgery, but although one finds passages which would not be accepted by the specialist in a particular branch the general balance of the book is good.

The method illustrated as "Russel traction" for fractured femur is not that described by Hamilton Russell. The floating patella test is given prominence for the presence of fluid in the knee-joint, but no mention is made of the simple test for fluctuation, a method which will surely detect a smaller quantity. No indication is given of the correct site of amputation in diabetic gangrene. For carcinoma of the prostate the suggested dose of stilbœstrol is probably too small, and the statement that carcinoma of the bladder is but little sensitive to radiotherapy does not accord with recent views expressed north of the Tweed. We should like to see all renal radiographs as viewed from the front of the patient; here most are shown as from the back.

The new section on burns mentions most of the present-day treatments; the statement that at present there is no agreement as to which method yields the best results is an admirable summary of a situation which must perplex students as much as surgeons.

The 1947 Year Book of General Surgery. Edited by EVARTS A. GRAHAM, A.B., M.D., Professor of Surgery, Washington University School of Medicine; etc. 7 × 4⅝ in. Pp. 734, with 201 illustrations. 1948. Chicago: The Year Book Publishers Inc. (London: H. K. Lewis & Co.). 21s. net.

THIS year book of general surgery is packed full of useful information, and there can be no doubt that American surgical literature has returned to its peace-time plane and military surgery is almost forgotten.

We are told that general surgery has almost ceased to exist, but this volume completely corrects such an impression and gives the reader a proper idea of the vastness of general surgery.

Professor Evarts Graham has the happy knack and ability of giving a concise and lucid description of all that is new in surgery, and reviewing the advances in their proper perspective. This is of real value not only to surgeons, but to all graduates who are attempting to become specialists in the domain of surgery.

Early Ambulation and Related Procedures in Surgical Management. By DANIEL J. LEITHAUSER, M.D., F.A.C.S., Chief of Surgery, St. Joseph Mercy Hospital, Detroit, Michigan. 9 × 6 in. Pp. 232 + xii, with 36 illustrations. 1948. Oxford: Blackwell Scientific Publications Ltd. 25s. net.

DURING the second world war the profession became conscious of the advantages of early ambulation following operative procedure; there was the added stimulus of getting service personnel back to duty as soon as possible.

The present book, which advocates early ambulation, puts forward the principal factors which are involved in the laparotomy syndrome, and gives some very practical details of surgical management which are advocated to minimize the mobility which is associated with abdominal surgery.

However, few surgeons would agree that the average acute appendicitis case only requires two days in hospital after operation.

Perhaps we are too conservative in our outlook regarding early ambulation, and if this is so this book should help to alter that view.

BOOK NOTICES

[*The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest to our readers.*]

Osteotomy of the Long Bones. By HENRY MILCH, M.D., Consulting Orthopædist, Maimonides Hospital; Attending Orthopædic Surgeon, Hospital of Joint Diseases and Riverside Hospital, New York. 9 × 6 in. Pp. 294 + xv, with 181 illustrations. 1948. Springfield, Ill.: C. C. Thomas. (Oxford: Blackwell Scientific Publications.) 35s. net.

Cineplasty. By HENRY H. KESSLER, M.D., Ph.D., Orthopædic and Amputation Consultant to the Office of Vocational Rehabilitation, U.S.A. 9 × 6 in. Pp. 201 + xi, with 199 illustrations. 1948. Springfield, Ill.: C. C. Thomas. (Oxford: Blackwell Scientific Publications.) 35s. net.

Paravertebral Block in Diagnosis, Prognosis, and Therapy. Minor Sympathetic Surgery. By FELIX MANDL, M.D., F.I.C.S., Professor of Surgery, Hodassah University Hospital, Jerusalem. Translated by GERTRUDE KALLNER, M.D. With a Foreword by MAX THOREK, M.D., F.I.C.S., Chicago. 9 × 6⅛ in. Pp. 330 + xvii, with 20 illustrations. 1948. London: William Heinemann (Medical Books) Ltd. 32s. net.

Excerpta Medica. Section IX, Surgery, 1947, Vol. 1, No. 1, September. 9¾ × 6⅝ in. Pp. 122. Amsterdam: Excerpta Medica Ltd. (Edinburgh: E. & S. Livingstone.) Per volume £6 4s.

Diseases of the Breast. By Sir CRISP ENGLISH, K.C.M.G., F.R.C.S., Consulting Surgeon, St. George's Hospital. 8½ × 5⅜ in. Pp. 128 + vii. 1948. London: J. & A. Churchill Ltd. 8s. 6d.

Surgery of the Ambulatory Patient. By L. KRAEER FERGUSON, A.B., M.D., F.A.C.S., Professor of Surgery, Graduate School of the University of Pensylvania; etc. With a Section on Fractures by LOUIS KAPLAN, B.A., M.D., F.A.C.S., Associate in Surgery, University of Pennsylvania. Second edition. 9 × 6 in. Pp. 932 + xxiii, with 645 illustrations. 1948. London: J. B. Lippincott Co. 72s. net.

The Science and Practice of Surgery. By W. H. C. ROMANIS, M.A., M.B., M.Ch. (Cantab.), F.R.C.S. (Eng.), F.R.S. (Edin.), Senior Surgeon and Lecturer on Surgery, St. Thomas's Hospital; and PHILIP H. MITCHINER, C.B., C.B.E., T.D., M.D., M.S. (Lond.), F.R.C.S. (Eng.), D.Ch. (Durham), Hon. Surgeon to H.M. The King; Hunterian Professor of Surgery, Royal College of Surgeons of England; Surgeon and Lecturer in Surgery, St. Thomas's Hospital. In two volumes. Eighth edition. 9¼ × 6 in. Vol. I, General Surgery. Pp. 892 + vi, with 409 illustrations and 20 plates. Vol. II, Regional Surgery. Pp. 955 + viii, with 316 illustrations and 8 plates. 1948. London: J. & A. Churchill Ltd. 1948. Each volume 25s. net.

Modern Plastic Surgical Prosthetics. By ADOLPH M. BROWN, M.A., M.D., Associate, Eye and Ear Infirmary, University of Illinois, Chicago, Ill. 9 × 6 in. Pp. 293 + xiv, with 180 illustrations. 1948. London: William Heinemann (Medical Books) Ltd. 35s. net.

Handbook on Fractures. By DUNCAN EVE, jun., M.D., F.A.C.S., Nashville, in collaboration with TRIMBLE SHARBER, A.B., M.D., Nashville. 9 × 6 in. Pp. 263 + xi, with 129 illustrations. 1948. London: Henry Kimpton. 25s. net.

The Foot and Ankle. By PHILIP LEWIN, M.D., F.A.C.S., Associate Professor of Bone and Joint Surgery, and Acting Head of Department, Northwestern University Medical School; etc. Third edition. 9½ × 5⅞ in. Pp. 847, with 389 illustrations, line drawings by HAROLD LAUFMAN, M.D., F.A.C.S. 1948. London: Henry Kimpton. 55s. net.

Les Embolies de l'Artère pulmonaire et des Artères des Membres. Physiologie pathologique et Traitement. By RENÉ LERICHE, Professeur au Collège de France. 9⅝ × 6½ in. Pp. 128, with 5 illustrations. 1947. Paris: Masson et Cie. 150 fr.

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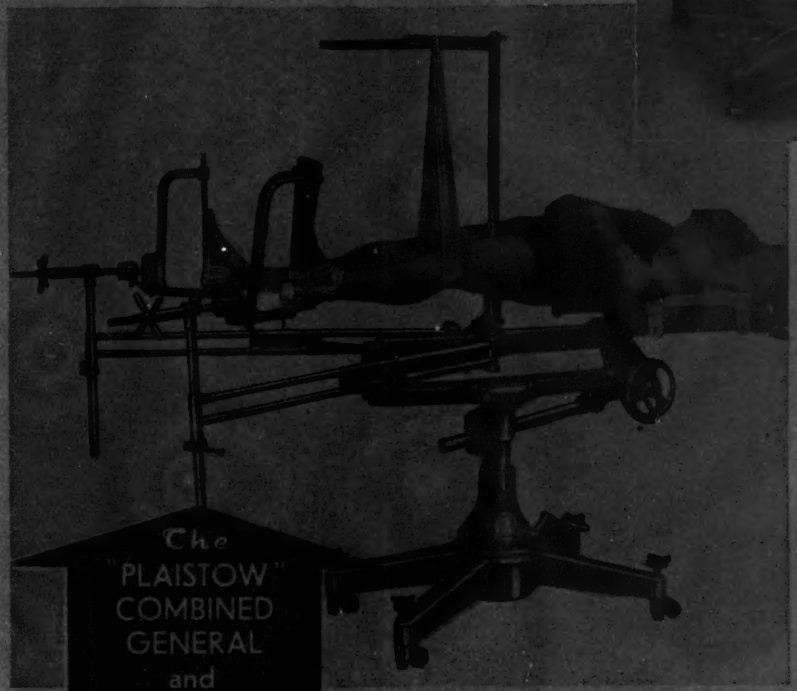

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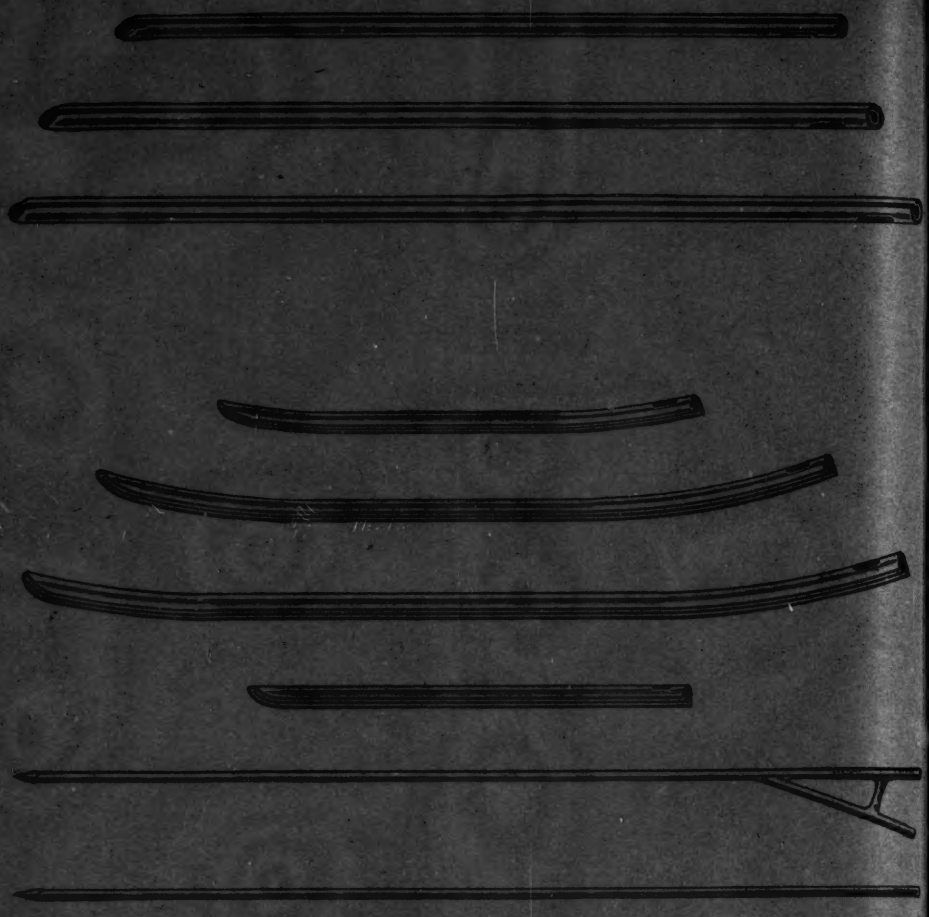

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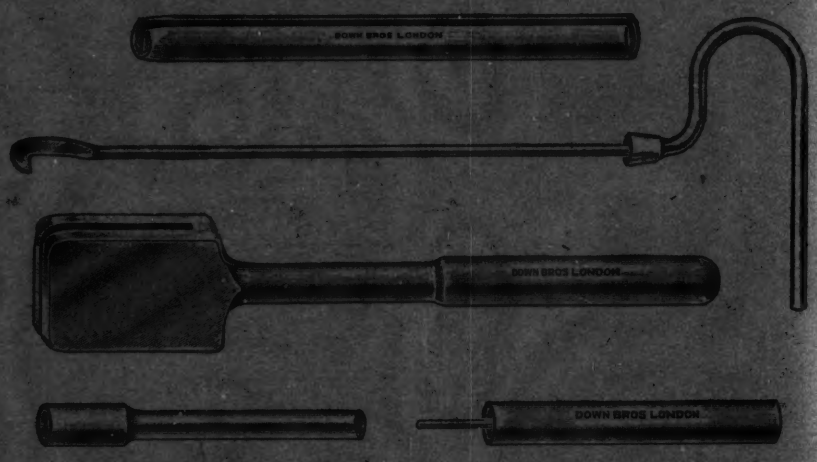

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